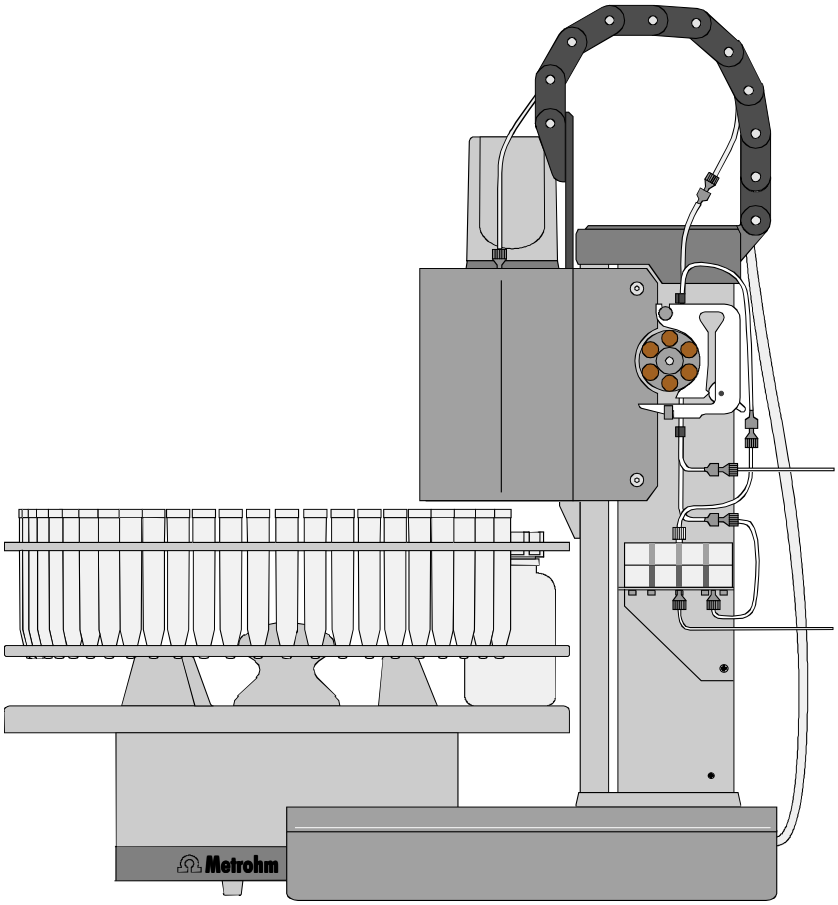
788 IC Filtration Sample Processor



Instructions for Use

8.788.1003

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788 IC Filtration Sample Processor

Instructions for Use

8.788.1003 03.2001 / up, dö

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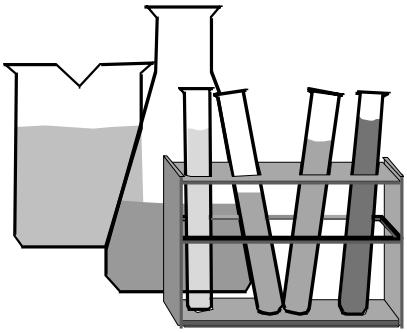


1 Introduction

1.1 Instrument description

The **788 IC Filtration Sample Processor** can be used for automating ion chromatographic determinations including in-line filtration, especially in combination with Metrohm IC system instruments. It is possible to apply and automate existing procedures for sample preparation using the ultra-filtration of the 788 IC Filtration Sample Processor.

The 127 sample tubes with a volume of 11 mL are arranged on the sample rack in three rows, which guarantees easy access and unrestricted programming. Two additional rinsing positions allow sample introduction free from cross-contamination even with widely varying sample matrices. Sample tubes made of polypropylene are standard. To protect the samples from external contamination, the tubes can be hermetically sealed.

Sample filtration and introduction to the injector is achieved by means of its integrated double-channel peristaltic pump. The sample is conveyed by one channel of the pump through the ultra-filtration cell passing the membrane. At the same time the filtrate is aspirated off from the rear of this membrane and transferred to the sample loop by the second channel of the pump. A PEEK needle for sealed or a PEEK tube for open sample tubes can be used alternatively.

The sequences for the processing of each sample are freely definable within broad boundaries. The same is true for the start and final sequences that are executed once either before or at the end of a sample series. With the help of the LEARN mode, which is provided for creating process methods, methods can be created easily and stored as user methods.

Preprogrammed standard methods for the most common modes of operation allow to use the 788 IC Filtration Sample Processor directly, with only little programming effort. The time frame can be given by the 788 IC Filtration Sample Processor; alternatively, the whole sequence can be managed by the «IC Net» remote control software via the «Queue» (sample table). The RS232 interface built in as standard allows remote control of the 788 IC Filtration Sample Processor from a PC.

1.2 Parts and controls

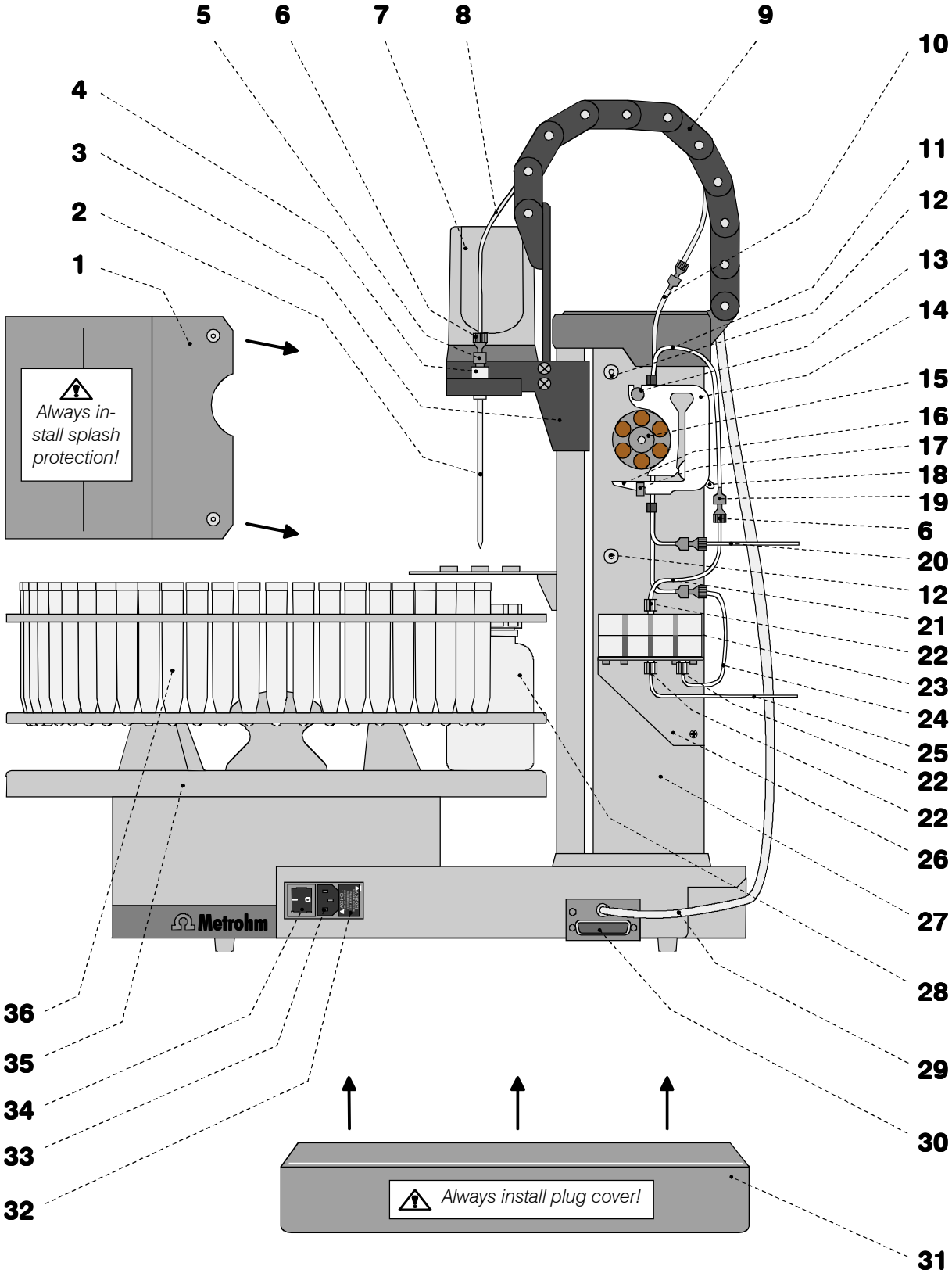


***Fig. 1*: Side view of the 788 IC Filtration Sample Processor**

1	**Splash protection (6.2751.040)** Must be installed always in operation!	**19**	**PEEK coupling (6.2744.030)** (Olive) Connecting compression fitting and pump tubing
2	**Needle** PEEK needle (6.1835.010) or PEEK tubing (6.1835.020)	**20**	**PEEK capillary (6.1831.060)** (1 m) For conveying the filtrate into the sample loop
3	**Lift** With swing head attached	**21**	**PTFE capillary (6.1803.050)** (0.5 mm / 0.2 m) Connecting ultra-filtration cell and filtrate pump tubing
4	**Needle guide (4.766.4330)** Attached (part of needle holder (6.2833.000))	**22**	**PVDF compression fitting (6.2744.000)** Connecting PTFE capillaries (6.1803.0X0) to ultra-filtration cell
5	**PEEK compression fitting (4.766.4320)** For PEEK needle or tubing	**23**	**Ultra-filtration cell (6.2729.110)** (Plexiglass)
6	**PEEK compression fitting (6.2744.010)** For connection of PEEK or PTFE capillaries 1/16 "	**24**	**PTFE capillary (6.1803.060)** (0.97 mm / 0.2 m) Connecting sample pump tubing and ultra-filtration cell
7	**Swing head** Attached	**25**	**PTFE capillary (6.1803.080)** (0.97 mm / 1 m) Connecting ultra-filtration cell and waste
8	**PTFE capillary (6.1803.070)** (0.97 mm / 0.40 m) Connection needle – pump tubing	**26**	**Cell holder** For ultra-filtration cell
9	**Guide chain** For fixing tubings and cables	**27**	**Tower**
10	**Pump tubing (6.1826.070)** (yellow/yellow) Conveying the sample to the ultra-filtration cell	**28**	**PE bottle (6.1608.080)** (300 mL)
11	**Pump tubing (6.1826.030)** (orange/yellow) Conveying the filtrate to the sample loop	**29**	**Connection cable for swing head** Attached, incl. branch plug for remote connection
12	**Screw thread for splash protection**	**30**	**Remote connection** For additional Metrohm instruments
13	**Mounting pin** For attaching the tubing cartridges	**31**	**Plug cover (6.2752.010)**
14	**Tubing cartridge (6.2755.000)** For pump tubing (6.1826.0X0)	**32**	**Fuse holder** Changing the fuses, see *section 2.2.2*
15	**Pump drive** Roller head with contact rollers	**33**	**Mains connection plug** Mains connection, see *section 2.2.3*
16	**Snap-action lever** For releasing the tubing cartridge	**34**	**Mains switch** For switching the instrument on/off: **I** = ON **0** = OFF
17	**Holding clamp** For locking the tubing cartridge into place	**35**	**Sample rack** (**6.2041.430)**
18	**Contact pressure lever** For adjusting the contact pressure	**36**	**PP sample tube (6.2743.050)** (11 mL) Can be sealed with 6.2743.070 PP caps

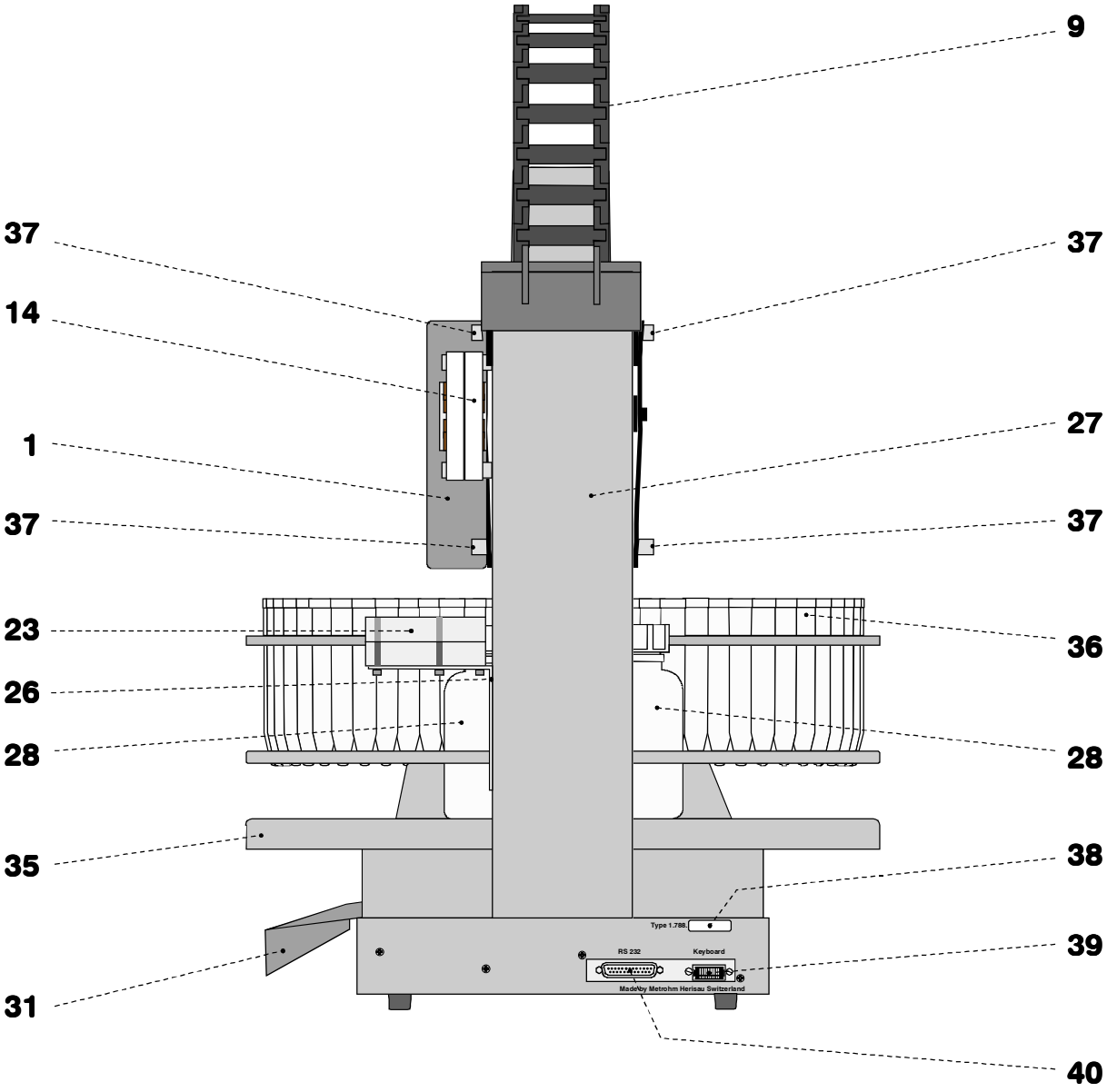


Fig. 2: Rear of the 788 IC Filtration Sample Processor

1	**Splash protection (6.2751.040)** Must be installed always in operation!	**35**	**Sample rack 6.2041.430**
9	**Guide chain** For fixing tubings and cables	**36**	**PP sample tube (6.2743.050)** (11 mL) Can be sealed with 6.2743.070 PP caps
14	**Tubing cartridges (6.2755.000)** For 6.1826.0X0 pump tubing	**37**	**Mounting screws for splash protection**
27	**Tower**	**38**	**Serial number**
28	**PE bottle (6.1608.080)** (300 mL)	**39**	**Keyboard connection**
31	**Plug cover (6.2752.010)**	**40**	**RS232 connection**

1.3 Information about the Instructions for Use

Please read through these Instructions for Use carefully before operating the 788 IC Filtration Sample Processor. The Instructions for Use contain information and warnings to which the user must pay attention in order to assure safe operation of the instrument..

1.3.1 Organization

These **8.788.1003 Instructions for Use** for the 788 IC Filtration Sample Processor provide a comprehensive overview of the installation, startup procedure, operation, fault rectification and technical specifications of this instrument. The Instructions for Use are organized as follows:

Section 1 Introduction
Description of the instrument, parts and controls, safety notes

Section 2 Installation
Mains connection, attachment of accessories, connection to IC systems

Section 3 Operating tutorial
Introduction to the operation

Section 4 Operation
Detailed description of display, keyboard, methods, manual operation, sample racks, standard methods, and filtration

Section 5 Interfaces
Remote interface, RS232 interface and remote control language

Section 6 Appendix
Error messages, technical data, maintenance and servicing, diagnosis, warranty, declaration of conformity, standard equipment, optional accessories, index

To find the information you require about the instruments please use either the **Table of contents** or the **Index** at the back. The **8.788.1013 Quick Reference Guide** is suitable for use as a reference work for daily use as it explains the most important parameters and key functions.

1.3.2 Notation and pictograms

The following notations and pictograms (symbols) are used in these Instructions for Use:

<PUMP>	**Switch or key**
15	**Part or control of 788**
89	**Part or control of 732/733**
26	**Part or control of 754**
'Bereich'	**Parameter or entry value** at 788 IC Filtration Sample Processor
******** counter 0/127 PUMP- ready	**Display** Text in keyboard display of 788 IC Filtration Sample Processor
	**Hazard** This symbol draws attention to a possible danger to life or injury if the associated directions are not followed correctly.
	**Warning** This symbol draws attention to possible damage to instruments or instrument parts if the associated directions are not followed correctly.
	**Caution** This symbol marks important information. Read these directions before continuing.
	**Comment** This symbol marks additional information and tips.

1.4 Support documentation

1.4.1 Application Bulletins

The «Application Bulletin» is a collection of analytical methods, application examples and literature references. All these Application Bulletins are available on request free of charge from your Metrohm supplier.

You will find an updated list of the Application Bulletins at any time under «http://www.metrohm.com».

1.4.2 Application Notes

The «Application Notes» present application information in concentrated form, i.e. on maximum 2 pages. You can order these free of charge from your Metrohm supplier or view them in the Internet under «http://www.metrohm.com» and copy them from there.

1.5 Safety notes

1.5.1 Electrical safety

While electrical safety in the handling of the 788 IC Filtration Sample Processor is assured in the context of the specifications IEC 1010-1 (protection class I), the following points should be noted:

- **Mains connection**

*Set the **mains voltage** and check the **mains fuse** and **mains connection** in accordance with the instructions in section 2.2.*

- **Opening the 788 IC Filtration Sample Processor**

*To avoid all danger of coming into contact with live components do not open the instrument or remove any parts when the 788 IC Filtration Sample Processor is connected to the power supply. Always disconnect the instrument from all voltage sources before you open it and ensure that the **mains cable is disconnected from mains connection 33** !*

- **Protection against static charges**

Electronic components are sensitive to static charging and can be destroyed by discharges. Before you touch any of the components inside the 788 IC Filtration Sample Processor, you should earth yourself and any tools you are using by touching an earthed object (e.g. housing of the instrument or a radiator) to eliminate any static charges which exist.

1.5.2 General safety rules

- **Install splash protection**

To avoid any danger of injury by the needle, the splash protection must always be installed when operating the 788 IC Filtration Sample Processor!

- **Install plug cover**

To prevent any contamination of the mains and remote connection by spilled solvents or chemicals, the plug cover must always be installed when operating the 788 IC Filtration Sample Processor!

- **Do not use caps together with the PEEK tube**

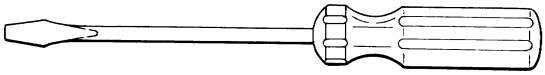
If you are using the 6.1835.020 PEEK tube, the sample tubes may not be sealed with caps because they cannot be pierced by the PEEK tubing and the tubing may be damaged thereby.

- **Handling of solvents**

Check the pump tubing and all input and output leads periodically for possible leaks. Follow the relevant instructions regarding the handling of flammable and/or toxic solvents and their disposal.

- **Regular exchange of pump tubings**

Pump tubings constitute consumable material and must be replaced from time to time (see section 6.3.3). Suitable measures must be taken so that any leak which might occur in the pump tubing or connections during unattended operation will cause no damage (collection device for any liquid which may leak out).



2 Installation

2.1 Setting up the instrument

2.1.1 Packaging

The 788 IC Filtration Sample Processor is supplied together with the separately packed accessories in special packaging containing shock-absorbing foam linings designed to provide excellent protection. The actual instrument is packed in an evacuated polyethylene bag to prevent the ingress of dust. Please store all these special packagings as only they can assure damage-free transport of the instrument.

2.1.2 Check

After receipt, immediately check whether the shipment is complete and undamaged (compare with delivery note and list of accessories in *section 6.8*). In the case of transport damage, see instructions in *section 6.7.1* "Warranty".

2.1.3 Location

Position the instrument in the laboratory at a location convenient for operation, free from vibrations and protected against a corrosive atmosphere and contamination by chemicals.

Do not operate the 788 IC Filtration Sample Processor without splash protection **1** *and plug cover* **31** *being installed!*

2.1.4 Arrangement of the instruments

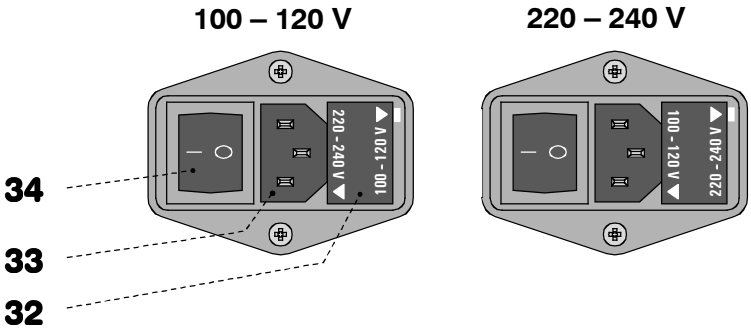
To make the connection for conveying the sample filtrate to the injection valve at the 733 IC Separation Center (or 761 Compact IC or 790 Personal IC) with the peek capillary **20** (length 1 m) supplied, position the 788 IC Filtration Sample Processor immediately on the left side of the IC system.

Take precautions to ensure that any leaks from pump tubings or connections cannot cause more damage.

2.2 Mains connection

Follow the instructions below for connecting to the power supply. If the instrument is operated with the mains voltage set wrongly and/or wrong mains fuse there is a danger of fire!

2.2.1 Setting the mains voltage



32	**Fuse holder**
33	**Mains connection plug**
34	**Mains switch**

Fig. 3: Setting the mains voltage

Before switching on the 788 IC Filtration Sample Processor for the first time, check that the mains voltage set on the instrument (see *Fig. 3*) matches the local mains voltage. If not, reset the mains voltage on the instrument as follows:

1 Disconnect mains cable

Disconnect mains cable from mains connection plug **33** of the 788 IC Filtration Sample Processor.

2 Remove fuse holder

Using a screwdriver, loosen fuse holder **32** beside the mains connection and take out completely.

3 Check fuse

Carefully take the fuse installed for the desired mains voltage out of fuse holder and check its specifications (the position of the fuse in the fuse holder is marked by the white arrow imprinted next to the mains voltage range):

100…120 V	**0.5 A (slow-blow)**	Metrohm-Nr. U.600.0013
220…240 V	**0.25 A (slow-blow)**	Metrohm-Nr. U.600.0010

4 Insert fuse

Change fuse if necessary and reinsert in fuse holder **32**.

5 Install fuse holder

Depending on the desired mains voltage, insert fuse holder **32** in the 788 IC Filtration Sample Processor so that the corresponding mains voltage range can be read normally and the adjacent white arrow points to the white bar imprinted on the right side of the fuse holder (see *Fig. 3*).

2.2.2 Fuses

One of the two fuses 0.5 A/slow-blow for 100…120 V or 0.25 A/slow-blow for 220…240 V is installed in fuse holder **32** of the 788 IC Filtration Sample Processor as standard.

Ensure that the instrument is never put into operation with fuses of another type, otherwise there is danger of fire!

For checking or changing fuses, proceed as described in *section 2.2.1*.

2.2.3 Mains cable and mains connection

Mains cable

The instrument is supplied with one of three mains cables

- 6.2122.020 with plug SEV 12 (Switzerland, …)
- 6.2122.040 with plug CEE(7), VII (Germany, …)
- 6.2133.070 with plug NEMA 5-15 (USA, …)

which are three-cored and fitted with a plug with an earthing pin. If a different plug has to be fitted, the yellow/green lead (IEC standard) must be connected to protective earth (protection class I).

Any break in the earthing inside or outside the instrument can make it a hazard!

Mains connection

Plug the mains cable into mains connection plug **33** of the 788 IC Filtration Sample Processor (see *Fig. 3*).

2.2.4 Switching the instrument on/off

The 788 IC Filtration Sample Processor is switched on and off using mains switch **34**.

2.3 Attaching the accessories

For attaching the accessories at the 788 IC Filtration Sample Processor, proceed in the order described below.

2.3.1 Connecting the swing head

Plug in the branch plug of the connection cable **29** permanently attached to the swing head into the remote connection socket at the 788 IC Filtration Sample Processor and screw it onto this connection using a screw-driver (see *Fig. 1*).

2.3.2 Connecting the keyboard

1 Connecting the keyboard

Connect the 6.2142.010 keyboard to the keyboard connection **39** "Keyboard". For disconnection, press the plug together slightly on both sides.

2 Switch on instrument

Switch on the 788 IC Filtration Sample Processor with mains switch **34**. The keyboard display lights up. The instrument is initialized and the lift is raised completely.

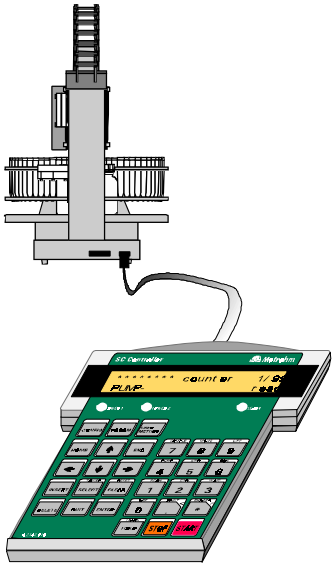


Fig. 4: Keyboard connection

2.3.3 Installing the plug cover

To prevent any contamination of the mains and remote connection by spilled solvents or chemicals, the 6.2752.010 plug cover must always be installed when operating the 788 IC Filtration Sample Processor!

Install the plug cover **31** in the corresponding guide groove above mains connection plug **33** and remote connection **30** (see *Fig. 1* and *Fig. 2*).

2.3.4 Installing the splash protection

To avoid any danger of injury by the needle, the 6.2751.040 splash protection must always be installed when operating the 788 IC Filtration Sample Processor!

1 Remove holding screws

Remove the holding screws **37** and the washer mounted on the screw threads **12** at tower **27** using the 6.2621.100 Allen key.

2 Remove protective film from splash protection

Remove the plastic film glued on both sides of the splash protection **1**.

3 Install splash protection

Attach splash protection onto the screw threads at the tower and fix it with the holding screws and the washer using the 6.2621.100 Allen key.

1 Splash protection (6.2751.040)

37 Holding screws

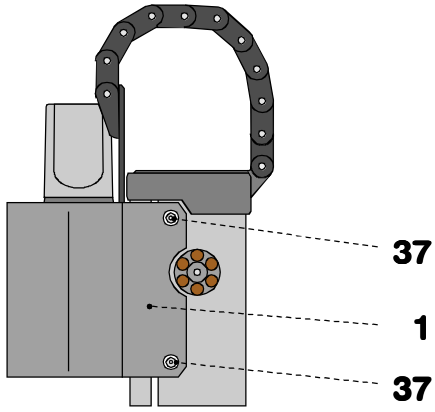


Fig. 5: Installing the splash protection

2.3.5 Installing the needle or tubing

1 Remove PEEK compression fitting 5

Remove PEEK compression fitting **5** screwed onto the needle holder **4**.

2 Insert needle

Insert needle **2** (6.1835.010) PEEK needle or 6.1835.020 PEEK tubing) completely into the opening of the needle holder **4**.

3 Fix needle or tubing

Tighten compression fitting **5** in needle holder **4** by hand (never use tools!).

2	**PEEK needle (6.1835.010) or PEEK tubing (6.1835.020)**
4	**Needle holder**
5	**PEEK compression fitting (4.766.4320)**
6	**PEEK compression fitting (6.2744.010)**
7	**Swing head**
8	**PTFE capillary (6.1803.070)**

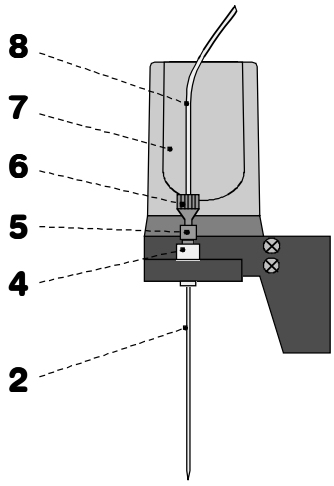


Fig. 6: Needle installation

If you are using the 6.1835.020 PEEK tubing, the sample tubes may not be sealed with caps because they cannot be pierced by the PEEK tubing and the needle may be damaged thereby.

2.3.6 Placing the sample rack

1 Place sample rack

Place sample rack **35** on the turntable of the 788 IC Filtration Sample Processor according to *Fig. 7*.

2 Read magnetic code

Press <RESET> to move the rack to the home position, in which the magnetic code can be read (details see *section 4.5*).

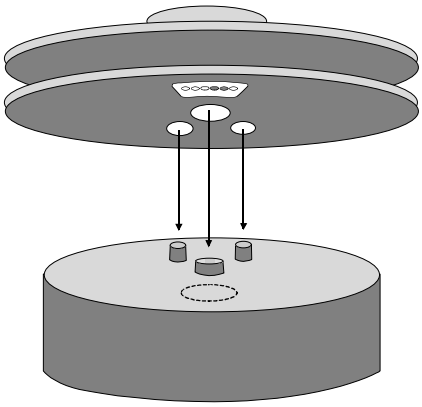


Fig. 7: Sample rack placing

2.3.7 Adjusting the sample rack

If a new sample rack is placed on the 788 IC Filtration Sample Processor for the first time, it must be adjusted on a rack position in the middle row (example: position 37) as follows:

1 Place sample rack

Place empty sample rack on the 788 IC Filtration Sample Processor and press <RESET> (see *section 2.3.6*).

2	**PEEK needle (6.1835.010) or PEEK tubing (6.1835.020)**
35	**Sample rack (6.2041.430)**
41	**Adjusting position 37**
42	**Adjusting screw**

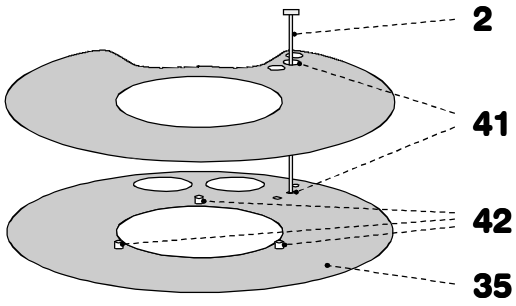


Fig. 8: Adjusting the sample rack

2 Move to adjusting position

Press <MOVE>, enter number '37' and confirm with <ENTER>. Sample rack and swing head are turned until needle is above the adjusting position 37 (first opening of the middle row).

3 Check needle position

- Press <🡻> until the needle is ca. 1 cm above the upper level of the sample rack.
- Check needle position: If the needle cannot be lowered unhindered through the upper hole of the adjusting position, continue directly with point **4**.
- Continue lowering the needle by pressing <🡻> until the needle is ca. 1 cm above the lower level of the sample rack.
- Check needle position: If the needle cannot be lowered unhindered through the lower hole of the adjusting position, continue directly with point **4**.
- Lower needle completely by pressing <🡻>.
- Check needle position: If the needle is in the middle of the lower hole, the sample rack must not be adjusted (continue in this case with point **5**).

4 Adjust sample rack

- Loosen the three adjusting screws **42** on the lower level of the sample rack using the 6.2621.100 Allen key.
- Carefully turn the two upper levels of the sample rack by hand until the lowered needle is exactly in the middle of the lower hole at the adjusting position **41**.
- Tighten the adjusting screws.

5 Move to rest position

Press <RESET> to move the sample rack to the rest position.

2.3.8 Assembling the ultra-filtration cell

In this section, the assembling of the ultra-filtration cell including the filtration membrane is described. Please consider section 4.7 for evaluating the membrane type and time of exchange. The exchange of filtration membranes is also described in section 6.3.4.

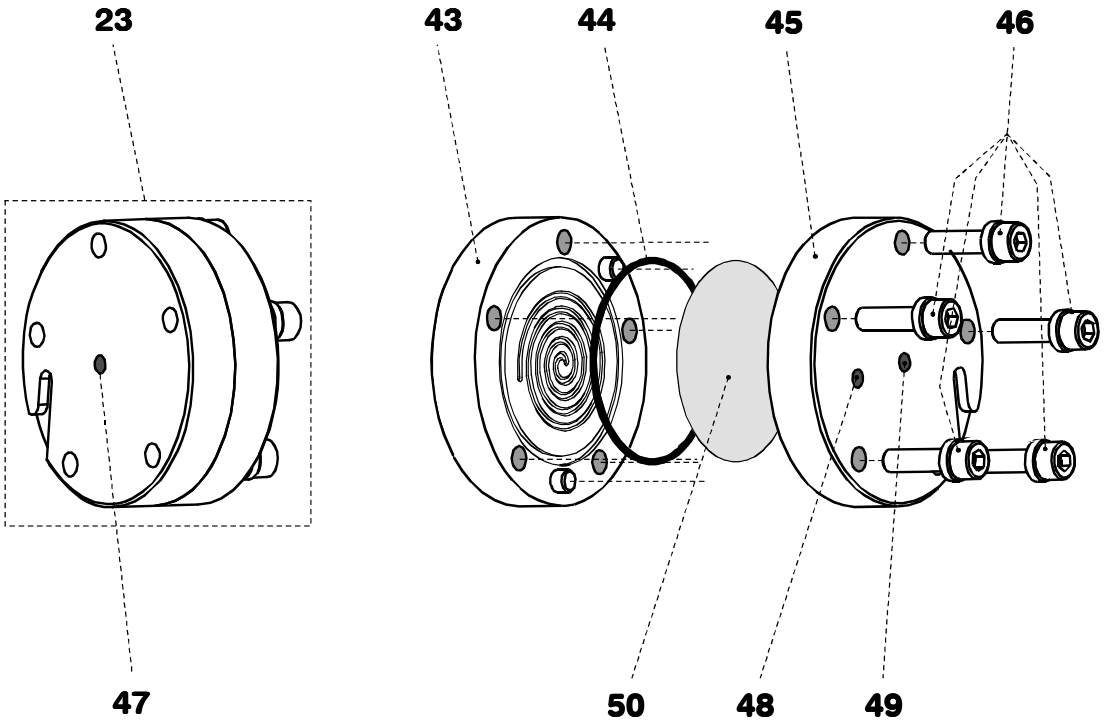


Fig. 9: Assembling the ultra-filtration cell

23	**Ultra-filtration cell (6.2729.110)**	**46**	**Screws V.022.6030 incl. washer 4.754.4090**
43	**Top part of the ultra-filtration cell**	**47**	**Outlet for sample filtrate**
44	**Sealing ring (E.301.0111)**	**48**	**Inlet for sample solution**
45	**Bottom part of the ultra-filtration cell**	**49**	**Outlet for sample solution**
50	**Filtration membrane (6.2714.020)**		

1 Prepare ultra-filtration cell

- Extract ultra-filtration cell **34** from its packaging and remove the four dummy stoppers.
- Using the 6.2621.070 Allen key, completely loosen the 5 screws **46**, separate top part **43** from bottom part **45** and remove sealing ring **44**.
- Thoroughly rinse the sealing ring, bottom part and top part of the dialysis cell with ultrapure water.

*Use only **ultrapure water** or **ethanol** to clean the dialysis cell; organic solvents (e.g. acetone) will cause damage to the plexiglas cell!*

2 Prepare filtration membrane

- Use the 6.2831.010 tweezers to extract a new filtration membrane **50** (6.2714.020) from its packaging and immerse in a Petri dish containing ultra pure water for approx. 2 min until the membrane is completely saturated with water.

Because the filtration membrane it is stretched out thereby, it has to be watered before inserting into the ultra-filtration cell. Otherwise, the membrane could be crumbled in the cell, which leads to blocking.

3 Insert filtration membrane

- Lay top part **43** on a paper wipe with its inside facing upwards.
- Insert sealing ring **44** in the appropriate recess in the top part.
- Using the tweezers, place the wet dialysis membrane inside the sealing ring on the top part of the filtration cell.

*Do not connect the dialysis cell with anything other than the **6.2744.000 PVDF compression fittings** supplied. If 6.2744.010 PEEK compression fittings are used, stress cracks may appear in the ultra-filtration cell !*

4 Close ultra-filtration cell

- Insert sealing ring in the appropriate recess in top part **43**.
- Place top part on bottom part **45** so that both parts lie flush.
- Using the 6.2621.070 Allen key, screw the 5 screws **46** right in and tighten up.

5 Attach ultra-filtration cell

- Insert the assembled ultra-filtration cell in the cell holder **26** according to Fig. 1 or Fig. 11. The heads of the five screws **46** fit to the small holes of the cell holder.

6 Rinse ultra-filtration cell

- Before rinsing the cell, please finish all tubing connections as described in the following sections.

- Every time the filtration membrane is changed, the remaining air in the cell and tubings has to be removed. This can be done by rinsing with ultrapure water.

- A completely installed 788 IC Filtration Sample Processor with ultra-filtration cell is required for processing the following steps. The rinsing solution (e.g. ultrapure water) is stored in a 300 mL PE bottle on the special beaker position 1. The 788 IC Filtration Sample Processor is online and in normal state. The pump is switched of (display: '`PUMP—'`) and the 788 is ready for use (display: '`ready`').

- Turn the sample rack to position the beaker with the rinsing solution under the needle by pressing <MOVE> followed by choosing '`spec.1`' with <SELECT>.

- Lower the lift into rinse position with <LIFT> and <SELECT> '`rinse`'

- Turn on the pump by pressing <PUMP>. All connected tubings and the ultra-filtration cell will be rinsed.

- After adequate time (e.g. 5 min.), switch off the Pump (<PUMP>) and raise the lift to its rest position by pressing <HOME>.

2.3.9 Tubing connections

The tubing connections on the 788 IC Filtration Sample Processor and the connection to the injection valve of the 733 IC Separation Center must be made as follows:

*Pump tubings are consumable material with a lifetime which depends on the contact pressure (see chapter 6.3.3). This is why the tubing cartridges should be raised completely by loosening snap-action lever **16** on the right-hand side if the pump is to remain switched off for a considerable length of time (the set contact pressure remains unchanged).*

The 6.1826.0X0 pump tubing is made of PVC and must not be used for rinsing with solutions which contain acetone. In such cases, rinse with different pump tubing or a different pump.

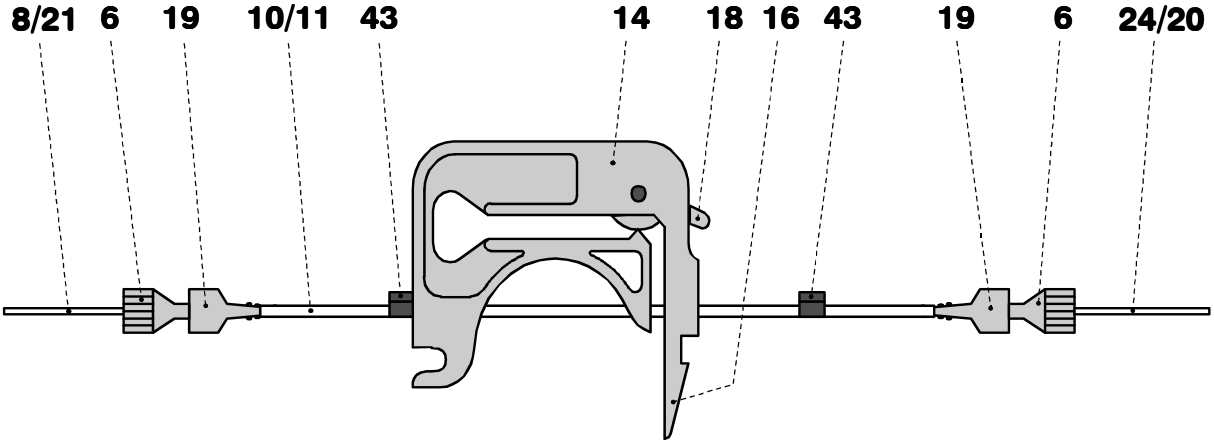


Abb. 10: Installing the pump tubing

	Line 1: Conveying the sample to the ultra-filtration cell		Line 2: Conveying the filtrate to the injection loop
8	**PTFE capillary (6.1803.070)**	**21**	**PTFE capillary (6.1803.050)**
6	**PEEK compression fitting (6.2744.010)**	**6**	**PEEK compression fitting (6.2744.010)**
19	**PEEK coupling (6.2744.030)**	**19**	**PEEK coupling (6.2744.030)**
10	**Pump tubing (6.1826.070)**	**11**	**Pump tubing 6.1826.030**
43	**Stopper (yellow/yellow)**	**43**	**Stopper (orange/yellow)**
14	**Tubing cartridge (6.2755.000)**	**14**	**Tubing cartridge (6.2755.000)**
18	**Contact pressure lever**	**18**	**Contact pressure lever**
16	**Snap-action lever**	**16**	**Snap-action lever**
24	**PTFE capillary (6.1803.060)**	**20**	**PEEK capillary (6.1831.060)**

1 Install pump tubing

- Release tubing cartridge **14** from holding clamp **17** by pressing down snap-action lever **16** and remove from mounting pin **13** on the 788 IC Filtration Sample Processor (see *Fig. 1*).
- Press contact pressure lever **18** on the tubing cartridge down as far as it will go.
- Insert pump tubings **10** and **11** in the tubing cartridges **13** as shown in *Fig. 10*. The black-black stopper **43** must click into the corresponding holder on the left-hand side of each tubing cartridge.
- Place both tubing cartridges on mounting pin **13** and press down on the right-hand side until snap-action lever **16** click into position on holding clamp **17**. Take care that no kinks are formed in the pump tubing.

2 Connection needle – pump tubing 10

- Mount a PEEK compression fitting **6** on both ends of the PTFE capillary **8**.
- Screw the PTFE capillary **8** with the PEEK compression fitting on to the PEEK compression fitting **5** already mounted on needle holder **4** (see *Fig. 6*).
- Insert PTFE capillary into the guide chain **9** (see *Fig. 1* and *section 2.3.10*).
- Screw a coupling **19** on to the PEEK compression fitting **6** at the other end of the PTFE capillary.
- Push coupling on to the inlet end of the pump tubing **10** (yellow/yellow, see *Fig. 10*).

6	**PEEK compression fitting (6.2744.010)**
10	**Pump tubing (6.1826.070)**
11	**Pump tubing 6.1826.030**
19	**PEEK coupling (6.2744.030)**
21	**PTFE capillary (6.1803.050)**
22	**PVDF compression fitting (6.2744.000)**
24	**PTFE capillary (6.1803.060)**
25	**PTFE capillary (6.1803.080)**
26	**Cell holder**
43	**Top part of the ultra-filtration cell**
45	**Bottom part of the ultra-filtration cell**

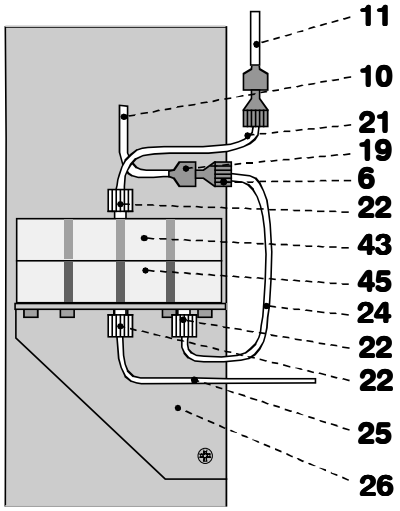


Fig. 11: Mount ultra-filtration cell

*Do not connect the dialysis cell with anything other than the **6.2744.000 PVDF compression fittings** supplied. If 6.2744.010 PEEK compression fittings are used, stress cracks may appear in the ultra-filtration cell !*

3 Connection pump tubing 10 – ultra-filtration cell

- Mount a PEEK compression fitting **6** on the end of the PTFE capillary **24** and screw it on to coupling **19**.
- Mount a PVDF compression fitting **22** on the other end of the PTFE capillary **24**.
- Screw this PEEK capillary with the PVDF compression fitting to inlet opening **48** of the bottom part of the cell (see *Fig. 9*).
- Push coupling **19** on to the outlet end of the pump tubing **10** (yellow/yellow) (see *Fig. 10*).

4 Connection ultra-filtration cell – waste

- Mount a PVDF compression fitting **22** on the end of the PTFE capillary **25**.
- Screw this end of the PTFE capillary with the PVDF compression fitting to outlet opening **49** of the bottom part of the cell (see *Fig. 9*).
- Mount the other end of the PTFE capillary to a waste bottle (e.g. optional: 6.1608.070 bottle with 6.1602.150 siphon GL45).

5 Connection ultra-filtration cell – pump tubing 11

- Mount a PEEK compression fitting **6** on the end of the PTFE capillary **21** and screw it on to coupling **19**.
- Mount a PVDF compression fitting **22** on the other end of the PTFE capillary **21**.
- Screw this PTFE capillary with the PVDF compression fitting to outlet opening for the filtrate **47** of the top part of the cell (see *Fig. 9*).
- Push coupling **19** on to the inlet end of the pump tubing **11** (orange/yellow) (see *Fig. 10*).

6 Connection pump tubing 11 – injection valve

(Underlined numbers are parts or controls from the Instructions for Use for the 733 IC Separation Center)

- Mount a PEEK compression fitting **6** on the end of the PEEK capillary **20** and screw it on to coupling **19**.
- Push coupling **19** on to the outlet end of the pump tubing **11** (orange/yellow) (see *Fig. 10*).
- At the 733 IC Separation Center, loosen the rotary nipple screwed onto the interior side of connection **22** or **28**.
- Take PTFE suction tubing **84** (see *Fig. 14* and *Fig. 15* of the 732/733 Instructions for Use) completely out of connection **22** or **28** and unscrew from connection "1" of injection valve **66**.

- Pull the PEEK capillary **20** through the opening **22** or **28** of the 733 IC Separation Center and screw onto connection "1" of injection valve **66** using a 6.2744.010 PEEK compression fitting **6**.
- Retighten rotary nipple on the interior side of connection **22** or **28** to fix the capillary **20**.

7 Tubing connection injection valve – waste

- Insert 6.2744.020 coupling (from 733 accessories) into connection **21** or **27** of the 733 IC Separation Center.
- Screw PTFE suction tubing **84** onto the 6.2744.020 coupling attached to connection **21** or **27** and lead it into the waste container.

In the case of the 733.0020 IC Separation Center with two injection valves, it is possible to fill both sample loops from the same 788 IC Filtration Sample Processor. For this, connection "1" of valve A (outlet of the sample loop) must be connected to connection "2" of valve B (inlet of the sample loop) using a 6.1803.040 PEEK capillary (15 cm).

2.3.10 Tubing connections 788 – 754 Dialysis Unit

If the 788 IC Filtration Sample Processor is used for an IC system with sample dialysis (see *section 2.4.7 or section 2.5.8*), the peristaltic pump at the 754 Dialysis Unit is used for sample conveying instead of the pump at the 788 IC Filtration Sample Processor. Additionally, the ultrafiltration cell is bridged. The tubing connections between the 754 Dialysis Unit and the 733 IC Separation Center have to be made as shown in *Fig. 8* of the *754 Instruction for Use*. The only change concerns the inlet of the sample, which is installed as follows:

Install a PEEK compression fitting 6.2744.010 on the inlet end of the PTFE tubing **26** (6.1803.030, see *Fig. 8 of the 754 Instruction for Use*) connected to the 754 Dialysis Unit and screw it on the PEEK compression fitting **5** (see *Fig. 6*).

2.3.11 Fixing tubing and cables

In order to fix tubing or cables in the guide chain **9** any chain link may be opened with a screw driver or another appropriate tool..

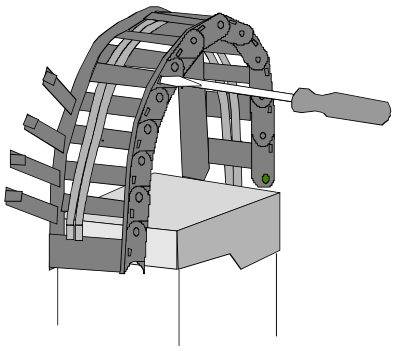


Fig. 12: Opening chain links

2.4 Installation for full control with «IC Net»

2.4.1 Connection options

The 788 IC Filtration Sample Processor can be connected to Metrohm IC Systems according to the following techniques:

1. The IC System is totally controlled by the PC software

Data acquisition and direct control of the IC components is done by the PC software «IC Net 2.1» in combination with the 762 IC Interface. The 788 IC Filtration Sample Processor is connected to the IC system both by the RS232 Interface and by the remote interface. Due to direct control of all procedures by the PC software, internal methods of the 788 IC Filtration Sample Processor are not used. This section describes several example combinations of the 788 IC Filtration Sample Processor with Metrohm IC systems based on this technique.

2. Compact IC Systems are remote controlled by PC software

Compact designed IC-Systems 761 Compact IC and 790 Personal IC are also controlled by the PC. The 788 IC Filtration Sample Processor is connected to these IC Systems by remote connection only. Therefore, internal methods of the sample processor are used. Please find a description of the connection of the 788 IC Filtration Sample Processor to the IC Systems 761 Compact IC and 790 Personal IC in *section 2.5*. The required 788 standard method is given in section 4.6.3.

3. The IC System is connected to PC for simple control

Instead of using the 762 IC Interface, modular Metrohm IC Systems can be simply controlled via the 714 PC Board or 771 IC Compact Interface. These devices just convert the analog signals from the 732 IC Detector to digital data for the PC. For simple control of the IC system, the 732 IC detector has to be connected to the PC additionally via its RS232 port. «IC Net» and the prior software «IC Metrodata» use this serial connection for a simple control of the IC system. As described for compact IC systems the 788 IC Filtration Sample Processor is connected to these IC Systems by remote connection. Also, internal methods of the Sample Processor are used. Please find a description of the connection of the 788 IC Filtration Sample Processor to such IC Systems in *section 2.6*. The use of the corresponding 788 standard methods is given in *section 4.6*.

2.4.2 General information on interface connections

Before an external device is connected to remote connection **30** *or RS232 interface* **40***, the 788 IC Filtration Sample Processor must always be switched off using mains switch* **34***!*

Remote connection

The branch plug of cable **29** leading from the swing head (see *Fig. 1*) is plugged into the 25 pin remote interface (see *section 2.3.1*). Any external devices can be connected to remote connection **30** of this branch plug. The 788 IC Filtration Sample Processor can be remote controlled via the 8 input lines, the 14 output lines can be used to control external devices.

The pin assignment of the remote interface, its functions, the electrical requirements and conditions are described in *section 5.1*.

RS232 interface

Many different instruments may be connected via the serial RS232 interface **40**. In addition to Metrohm instruments (e.g. 762 IC Interface) that support the Metrohm remote control language (see *section 5.2*) any printer with serial interface (or parallel interface and parallel/serial converter) or a personal computer (PC) may be connected (see *section 2.7*). Other measuring instrument may be controlled via RS232 interface, as long as it supports serial data transmission.

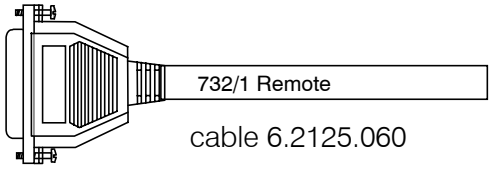
In order to guarantee safe data transmission, it is important to set the same RS232 interface parameters correctly for both instruments connected (see *section 4.2.1*).

Connection cables

Connecting peripheral instruments to the 788 IC Filtration Sample Processor requires Metrohm cables. Otherwise a safe data transmission may not be guaranteed.

Metrohm cables are labeled with the type of the instrument, which they may be connected with and optionally with the particular socket. Mind the cable ends.

Example:



cable 6.2125.060

2.4.3 Metrohm IC systems

Metrohm IC systems can be classified into modular IC systems ("**MIC**") and compact IC systems (e.g. **761 Compact IC** or **790 Personal IC**). The following table gives a review over pre-configured Metrohm IC systems:

Name	*Application*
MIC 1	Anion or cation system with electronic suppression
MIC 2	Anion system with chemical suppression
MIC 3	Anion and cation system with chemical suppression
MIC 4	Anion or cation system with electronic suppression and preconcentration
MIC 5	Anion system with chemical suppression and preconcentration
MIC 6	Anion system with chemical suppression, preconcentration and matrix elimination
MIC 7	Anion system with chemical suppression and dialysis

The following sections describe the electronic connection of some of these systems with the 788 IC Filtration Sample Processor on the base of full control by «**IC Net 2.1**». Due to similar compilation of MIC 1 / MIC 4 and MIC 2 / MIC 5, only the common used systems **MIC 1** und **MIC 2** are described. Additionally, the anion and cation system **MIC 3** as well as the dialysis system **MIC 7** are included. Please note that with the MIC 7 system the 788 IC Filtration Sample Processor can be used for dialysis in combination with the 754 Dialysis Unit. For this purpose, the ultra-filtration cell of the 788 IC Filtration Sample Processor should be bridged (see *section 2.3.10*).

For connecting the 788 IC Filtration Sample Processor to **761 Compact IC** and **790 Personal IC**, the remote connection is used only. Therefore, internal methods of the sample processor are used. Please find the corresponding descriptions in *section 2.5* (connection) and *section 4.6.3* (methods).

2.4.4 MIC 1 Modular anion or cation system with electronic suppression

The 788 IC Filtration Sample Processor is connected to an IC system with electronic suppression consisting of 732 IC Detector, 733 IC Separation Center, 709 IC Pump and 762 IC Interface as shown in *Fig. 13* using the 6.2141.110 remote connection cable and the 6.2134.080 RS232 cable.

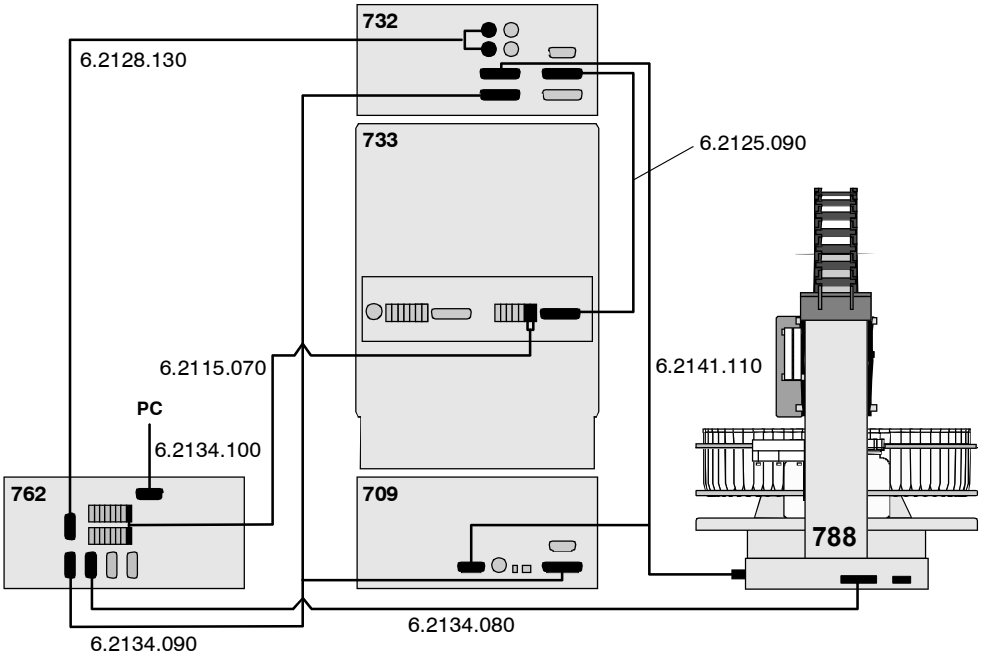


Fig. 13: ***Interconnection with anion or cation IC system with electronic suppression (MIC 1)***

Settings in the «IC Net 2.1» program

Creation of a time program for the 788 IC Filtration Sample Processor:

001	**Ctrl**	**INIT 732**	– Initialize remote interface at 732
002	**Move**	**sample**	– Move needle to sample
003	**Lift**	**work**	– Place lift with needle to working position
004	**Ctrl**	**ZERO 1**	– Trigger autozero at 732
005	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
006	**Pump**	**240 s**	– Fill sample loop with sample during 240 s
007	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"

2.4.5 MIC 2 Modular anion system with chemical suppression

The 788 IC Filtration Sample Processor is connected to an anion IC system with chemical suppression consisting of 732 IC Detector, 733 IC Separation Center, 709 IC Pump, 752 IC Pump Unit, and 762 IC Interface as shown in *Fig. 14* using the 6.2141.110 remote connection cable and the 6.2134.080 RS232 cable.

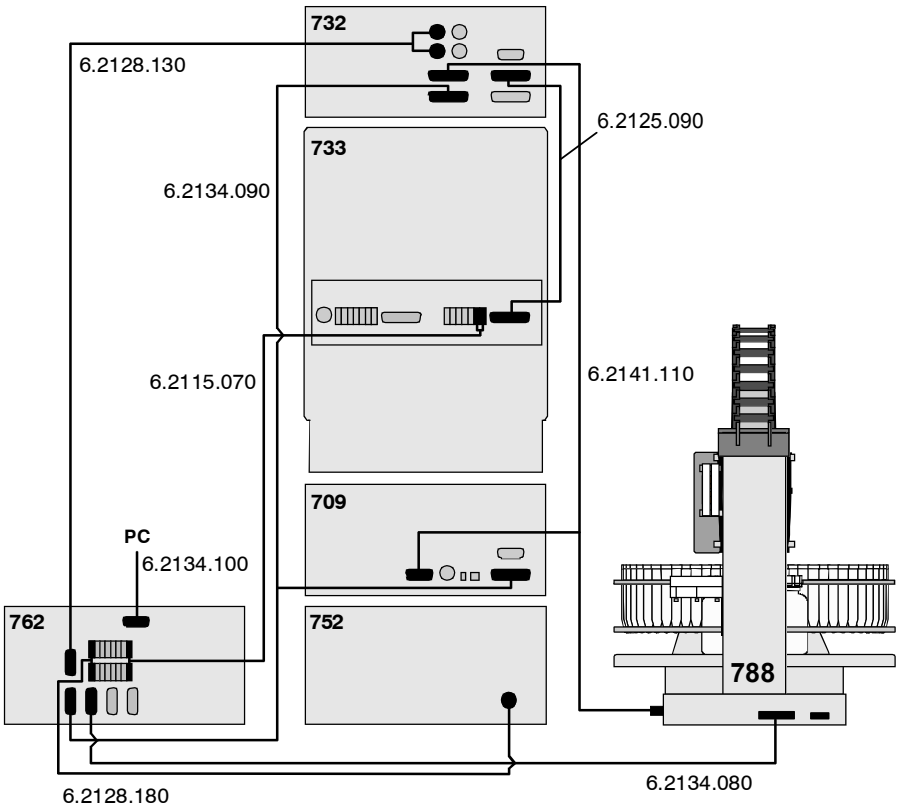


Fig. 14: ***Interconnection with anion IC system with chemical suppression (MIC 2)***

Settings in the «IC Net 2.1» program

Creation of a time program for the 788 IC Filtration Sample Processor:

001	**Ctrl**	**INIT 732**	– Initialize remote interface at 732
002	**Move**	**sample**	– Move needle to sample
003	**Lift**	**work**	– Place lift with needle to working position
004	**Ctrl**	**ZERO 1**	– Trigger autozero at 732
005	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
006	**Pump**	**240 s**	– Fill sample loop with sample during 240 s
007	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"

2.4.6 MIC 3 Modular anion and cation system with chemical suppression

The modular anion and cation system can be operated with chemical or electronic suppression. The 788 IC Filtration Sample Processor is connected to the MIC 3 system consisting of two 732 IC Detectors, 733 IC Separation Center (two injectors), two 709 IC Pumps, 753 IC Suppressor Module (if suppression is used), and the 762 IC Interface as shown in *Fig. 15* using the 6.2125.120 remote adapter, the 6.2125.090 remote connection cable and the 6.2134.080 RS232 cable.

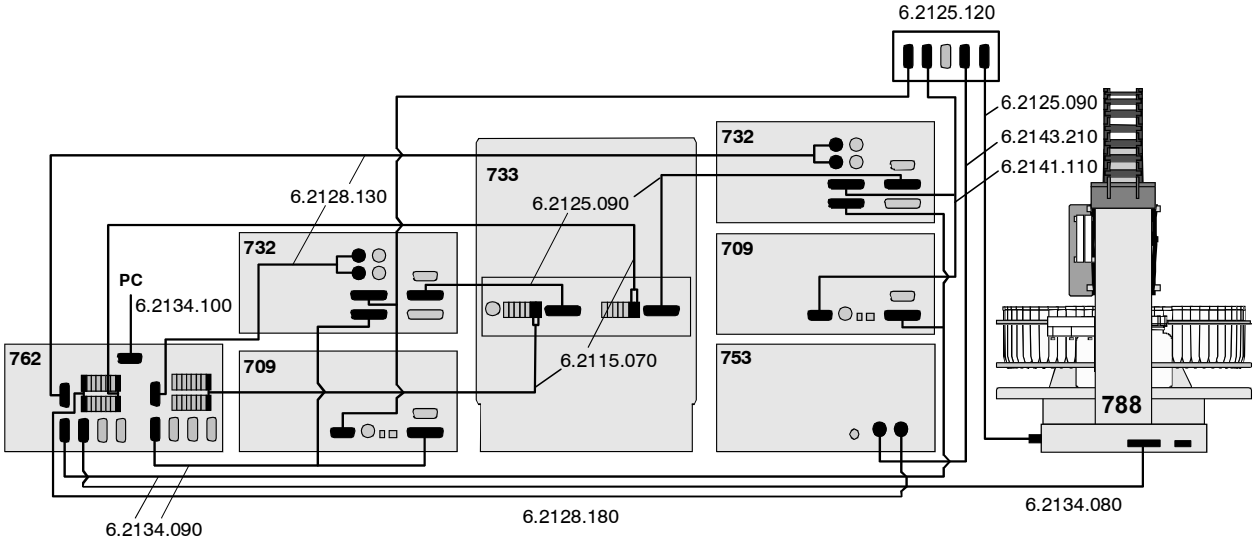


Fig. 15: ***Interconnection with the combined anion and cation IC system with chemical suppression (MIC 3)***

Settings in the «IC Net 2.1» program

1. Definition of new program parameters for the 788 IC Filtration Sample Processor under *Configuration*/*Control*:

FILL A 2 = ---*0*010*****
INJECT A 2 = ---*1*000*****
ZERO 2 = ---*0*011*****

2. Program for the 788 IC Filtration Sample Processor:

001	**Ctrl**	**INIT**	– Initialize remote interface
002	**Move**	**sample**	– Move needle to sample position
003	**Lift**	**work**	– Place lift with needle to working position
004	**Ctrl**	**ZERO 1**	– Trigger autozero at 732/1 IC Detector
005	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
006	**Ctrl**	**STEP MSM 753**	– Switch 753 suppressor module to next position
007	**Pump**	**240 s**	– Fill sample loop A with sample during 240 s
008	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"
009	**Move**	**sample+1**	– Move needle to sample position (+1)
010	**Lift**	**work**	– Place lift with needle to working position
011	**Ctrl**	**ZERO 2**	– Trigger autozero at 732/2 IC Detector
012	**Ctrl**	**Init 732**	– Initialize remote lines at 732/1 and 732/2
013	**Scan**	**Wait1**	– Wait until 732/1 IC Det. sends signal on remote line 3
014	**Ctrl**	**FILL A 2**	– Switch injection valve B at 733 to "Fill"
015	**Ctrl**	**Init 732**	– Initialize remote lines at 732/1 and 732/2
016	**Pump**	**240 s**	– Fill sample loop B with sample during 240 s
017	**Ctrl**	**INJECT A 2**	– Switch injection valve B at 733 to "Inject"
018	**Ctrl**	**Init 732**	– Initialize remote lines at 732/1 and 732/2

3. Definition of new program parameters for the 723/1 IC Detector under *Programm*/*Remote Configuration*:

Start_788 =1*****
Reset_Start_788 =0*****

4. To synchronize the second injection to the start of the second chromatogram, a time program is started for the 732/1 IC Detector directly with the first injection:

1.0 Start_788
1.1 Reset_Start_788
1.2 Flag end

Both detectors 732/1 and 732/2 are registered in the system window under *Setup*/*Start mode* in the field '*Start with inject*' .

4. By this procedure, with a delay of one minute, the 788 IC Filtration Sample Processor receives a signal for processing the second sample. The total resulting delay (5 min.) is now independent from the time the sampler needs for rotating to the next sample. Therefore, the method for the second sample injection (e.g. method '*cation*') gets a start delay under *Method Setup*/*Measure*:

Start delay: 5.0 min

2.4.7 MIC-7 Modular anion system with chemical suppression and dialysis

It is possible to operate the 788 IC Filtration Sample Processor in combination with an anion IC system with dialysis. For this purpose, the ultra-filtration cell of the 788 IC Filtration Sample Processor should be bridged (see *section 2.3.10*).

The 788 IC Filtration Sample Processor is connected to this anion IC system consisting of 732 IC Detector, 733 IC Separation Center (two injectors), 709 IC Pump, 753 IC Suppressor Module, 754 IC Dialysis Unit, and 762 IC Interface as shown in *Fig. 16* using the 6.2125.120 remote adapter, the 6.2125.090 remote connection cable and the 6.2134.080 RS232 cable.

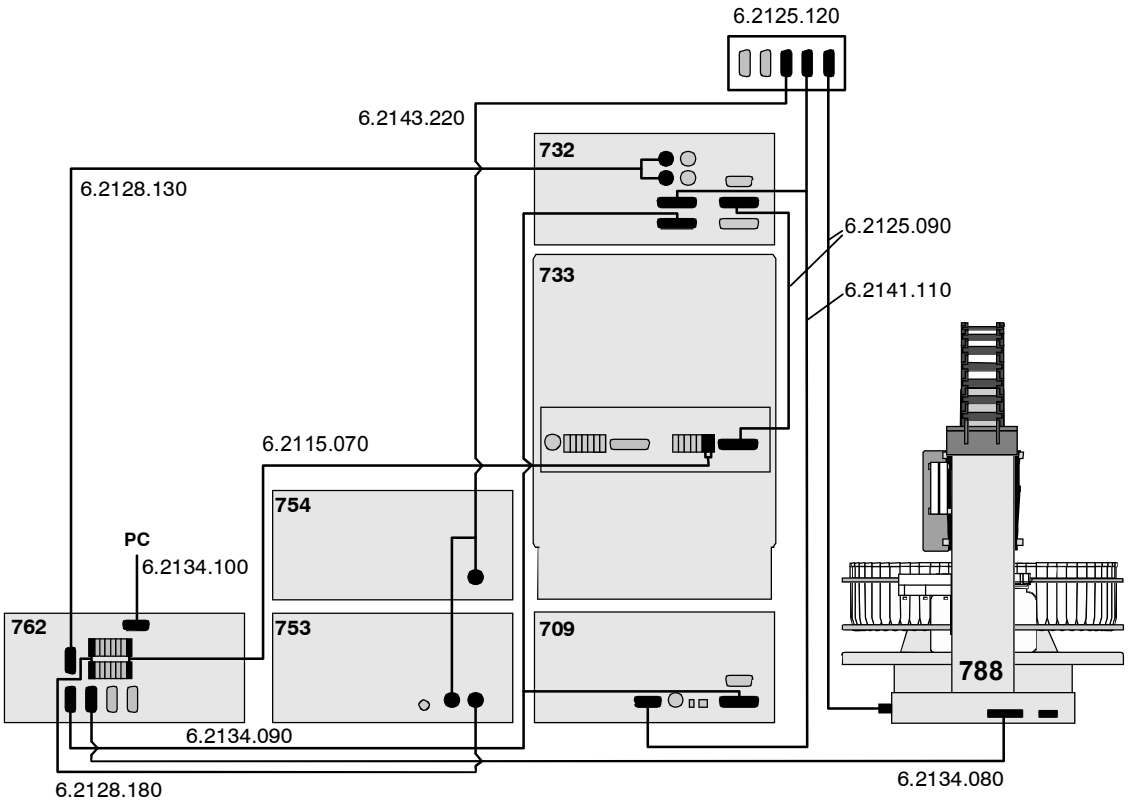


Abb. 16: Interconnection with anion IC system with chemical suppression and dialysis (MIC 7)

Settings in the «IC Net 2.1» program

There are two ways to operate an automated Metrohm IC system with dialysis:

A) For each sample, every analysis procedure contains first a dialysis step followed by the chromatographic separation.

⇒ The total analysis time per sample results from summation of the single times of dialysis and separation.

B) Chromatographic separation of one sample and dialysis of the next sample is done simultaneously.

⇒ The total analysis time per sample is reduced to the time of chromatographic separation.

Both techniques are described on the following pages.

A) Dialysis and separation of one sample in a single procedure

1. Definition of new program parameters for the 788 IC Filtration Sample Processor under *Configuration*/*Control*:

PUMP 754 on = ---**1******
PUMP 754 off = ---**0******

2. Program for the 788 IC Filtration Sample Processor:

001	**Move**	**sample**	– Move needle to sample position
002	**Lift**	**work**	– Place lift with needle to working position
003	**Ctrl**	**PUMP 754 on**	– Start 754 Pump Unit
004	**Wait**	**120 s**	– Rinse dialysis cell with sample solution
005	**Ctrl**	**FILL B 1 / STEP**	– Stop of acceptor solution
006	**Wait**	**480 s**	– Dialysis time
007	**Ctrl**	**ZERO 1**	– Trigger autozero at 732 IC Detector
008	**Ctrl**	**STEP MSM 753**	– Switch 753 suppressor module to next position
009	**Wait**	**120 s**	– Additional dialysis time (total 600 s)
010	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
011	**Ctrl**	**INJECT B 1**	– Transfer acceptor solution to sample loop
012	**Wait**	**30 s**	– Fill sample loop with acceptor solution for 30 s
013	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"
014	**Ctrl**	**PUMP 754 off**	– Stop 754 Pump Unit

B) Separation with simultaneous dialysis of the next sample

The following time program descriptions are based on chromatogram times of 20 minutes. Approx. 10 minutes before end of each separation the dialysis of the next sample is started. For this purpose, the 788 program in the system dialysis.smt contains a waiting time of 540 s in line 006 (see below). These values have to be adapted, if necessary.

A main time program for the 788 IC Filtration Sample Processor is needed, which controls the both the injection of a dialyzed sample as well as the dialysis of the following sample: ('dialysis.smt').

The processing of the first and last sample of a queue requires time programs in additional system files. The 788 program in the system file 'start-dialysis.smt' just starts the dialysis of the first sample. 'end-dialysis.smt' is used to inject the acceptor solution of the last sample.

dialysis.smt

1. Definition of new program parameters for the 788 IC Filtration Sample Processor under *Configuration*/*Control*:

PUMP 754 on	**= ---****1********
PUMP 754 off	**= ---****0********

2. Program for the 788 IC Filtration Sample Processor:

001	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
002	**Ctrl**	**INJECT B 1**	– Transfer acceptor solution to sample loop
003	**Wait**	**30 s**	– Fill sample loop with acceptor solution for 30 s
004	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"
005	**Ctrl**	**PUMP 754 off**	– Stop 754 Pump Unit
006	**Wait**	**540 s**	– Wait: 540 s
007	**Move**	**sample+1**	– Move needle to sample position (+1)
008	**Lift**	**work**	– Place lift with needle to working position
009	**Ctrl**	**PUMP 754 on**	– Start 754 Pump Unit
010	**Wait**	**120 s**	– Rinse dialysis cell with sample solution
011	**Ctrl**	**FILL B 1 / STEP**	– Stop of acceptor solution
012	**Wait**	**540 s**	– Dialysis time
013	**Ctrl**	**STEP MSM 753**	– Switch 753 suppressor module to next position
014	**Ctrl**	**ZERO 1**	– Trigger autozero at 732 IC Detector
015	**Wait**	**60 s**	– Additional dialysis time (total 600 s)

start-dialysis.smt

3. Save the system file 'dialysis.smt' with a new name 'start-dialysis.smt'.

4. Remove the data recorder by clicking on the recorder icon with the right mouse button an selecting '*unlink*'

5. Change this program for 'start-dialysis.smt' as follows and save it again:

001	**Ctrl**	**INIT 732**	– Initialize remote lines at 732 detector
002	**Move**	**sample**	– Move needle to sample position
003	**Lift**	**work**	– Place lift with needle to working position
004	**Ctrl**	**PUMP 754 on**	– Start 754 Pump Unit
005	**Wait**	**120 s**	– Rinse dialysis cell with sample solution
006	**Ctrl**	**FILL B 1 / STEP**	– Stop of acceptor solution
007	**Wait**	**540 s**	– Dialysis time
008	**Ctrl**	**STEP MSM 753**	– Switch 753 suppressor module to next position
009	**Ctrl**	**ZERO 1**	– Trigger autozero at 732 IC Detector
010	**Wait**	**60 s**	– Additional dialysis time (total 600 s)

End-Dialysis.smt

6. Open system file 'dialysis.smt', again. Select *Control*/*Connect to Workplace* and save it under the new name 'end-dialysis.smt'.

7. Change the program for 'end-dialysis.smt' as follows and save it again:

001	**Ctrl**	**FILL A 1**	– Switch injection valve A at 733 to "Fill"
002	**Ctrl**	**INJECT B 1**	– Transfer acceptor solution to sample loop
003	**Wait**	**30 s**	– Fill sample loop with acceptor solution for 30 s
004	**Ctrl**	**INJECT A 1**	– Switch injection valve A at 733 to "Inject"
005	**Ctrl**	**PUMP 754 off**	– Stop 754 Pump Unit

8. The sample queue then contains the following entries, for example:

	System	Ident	Vial	Chrom. No.	Dialysis No.
1	**start-dialysis.smt**	**Probe 0**	**1**	-	1
2	**dialysis.smt**	**Probe 1**	**1**	1	2
3	**dialysis.smt**	**Probe 2**	**2**	2	3
4	**dialysis.smt**	**Probe 3**	**3**	3	4
5	**dialysis.smt**	**Probe 4**	**4**	4	5
6	**dialysis.smt**	**Probe 5**	**5**	5	6
7	**end-dialysis.smt**	**Probe 6**	**6**	6	-

This example describes the processing of a queue with six samples. The columns 'Chrom. No.' and 'Dialysis No.' are just given for information. Please note that in the 788 program of 'dialysis.smt' not the given sample position 'Vial' is used; it is increased by 1 to start dialysis of the next sample. Therefore, all samples have to be arranged on the sample rack in a closed line.

2.5 Installation with compact IC systems

2.5.1 Connection to 761 Compact IC or 790 Personal IC

Compact IC systems 761 Compact IC and 790 Personal IC are remote controlled by PC software. The 788 IC Filtration Sample Processor is connected to these IC systems via its remote connection:

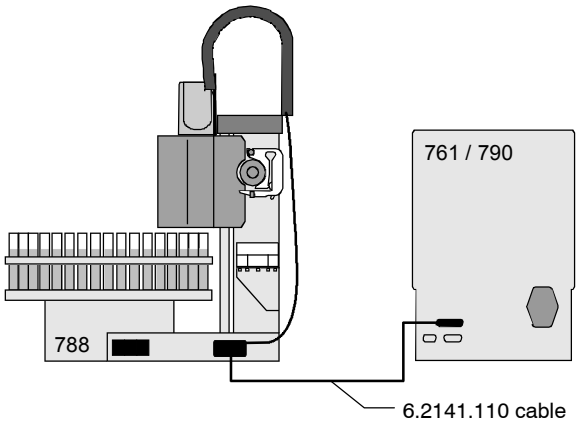


Fig. 17: Interconnection with compact IC systems

Tubing connections are described in section 2.10.2 of the instructions for use for the 761 Compact IC and 790 Personal IC, respectively.

The 6.2141.110 remote cable is needed for connecting the 788 IC Filtration Sample Processor to the compact IC system (761 or 790) as follows:

Electrical connection 788 – 761/790

- Connect the end of the 6.2141.110 Cable marked with "766" to the remote interface **30** 788 IC Filtration Sample Processor.
- Connect the end of the 6.2141.110 Cable marked with "732/1" to the remote interface of the 761 Compact IC and 790 Personal IC respectively.
- The third end of this cable is not required with this configuration.

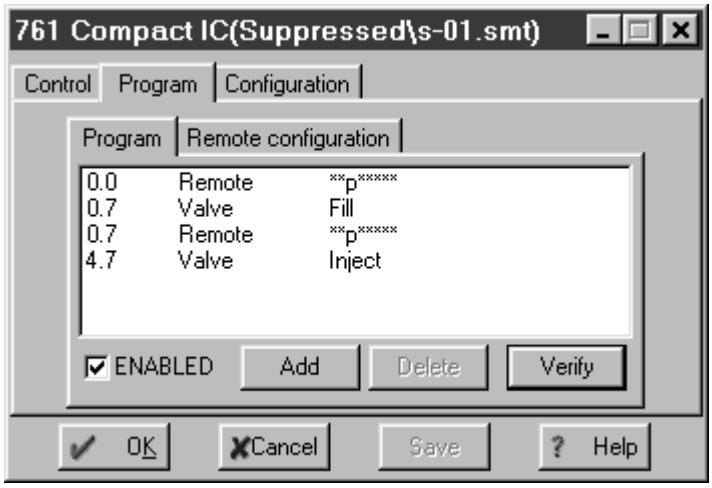
Settings at the 788 IC Filtration Sample Processor

- For operation with the 761 Compact IC or 790 Personal IC it is recommended that the program "761" is used with the 788 IC Filtration Sample Processor (see *section 4.6.3*):

The corresponding settings in the PC software vary according to the IC system which is used:

Settings in the «761 Compact IC» program

A time program must be drawn up for the selected system which first produces an impulse at remote lead 3 to start sample changing on the 788 IC Filtration Sample Processor and then switches the injection valve to the "Fill" position. A further impulse is then produced to start filling the sample loop within 240 s. At the end the injection valve is switched to the "Inject" position, which also starts data acquisition.



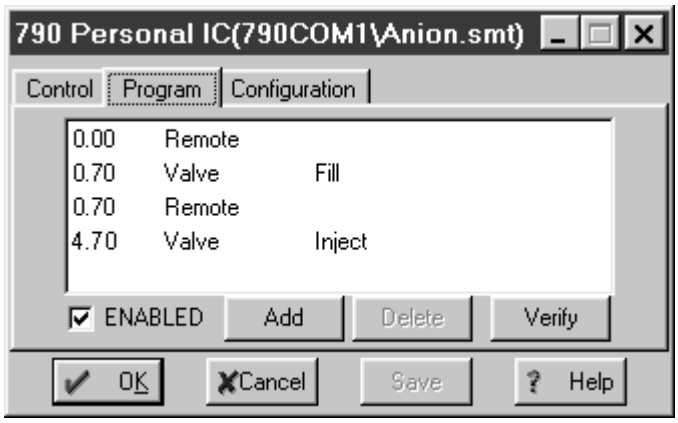
Run conditions

In order that the joint operation of 761 – 788 functions properly the following conditions must be fulfilled:

- The program must be started first on the 788 IC Filtration Sample Processor, then the "Sample Queue" on 761 Compact IC.
- Remote lead 3 on the Compact IC must be set to 0 at the start of each determination (Set **System startup values**: **Remote line 3 = 0**).

Settings in the «790 Personal IC» program

A time program must be drawn up for the selected system which first produces an impulse at remote lead 3 to start sample changing on the 788 IC Filtration Sample Processor and then switches the injection valve to the "Fill" position. A further impulse is then produced to start filling the sample loop within 240 s. At the end the injection valve is switched to the "Inject" position, which also starts data acquisition.



Run conditions

In order that the joint operation of 790 – 788 functions properly the program must be started first on the 788 IC Filtration Sample Processor, then the "Sample Queue" on 790 Personal IC.

2.6 Installation for simple remote control of the IC system

Using the 714 PC Board or 771 IC Compact Interface a simple interconnection of modular IC systems to a PC can be established. These devices just convert the analog signals from the 732 IC Detector to digital data for the PC.

For simple control of the IC system, the 732 IC detector has to be connected to the PC additionally via its RS232 port. «IC Net» and the prior software «IC Metrodata» use this serial connection for a simple control of the IC system.

As described for compact IC systems the 788 IC Filtration Sample Processor is connected to these IC Systems by remote connection. Also, internal methods of the Sample Processor are used. In the present chapter, a description of the connection of the 788 IC Filtration Sample Processor to such IC Systems is given. The use of the corresponding 788 standard methods is given in *section 4.6*.

For this type of simple remote control of the IC System the 732 IC Detector is used as "Master".

Another version of PC connection for modular IC systems includes only signal transmission and conversion to digital data using the 714 PC Board or 771 IC Compact Interface. All methods and programs are directly edited at the 732 IC Detector or 788 IC Filtration Sample Processor. One of these instruments then holds the time control of the program and operated as "Master".

Examples for these different configurations are given in the following sections.

2.6.1 IC system without suppression

The 788 IC Filtration Sample Processor is connected to an IC system without suppression consisting of 732 IC Detector, 733 IC Separation Center and 709 IC Pump as shown in *Fig. 18* using the 6.2141.110 cable. With this interconnection the standard methods **'PC'**, **'PC Seg'**, **'SP'** and **'SP Seg'** can be used (see *section 4.6*).

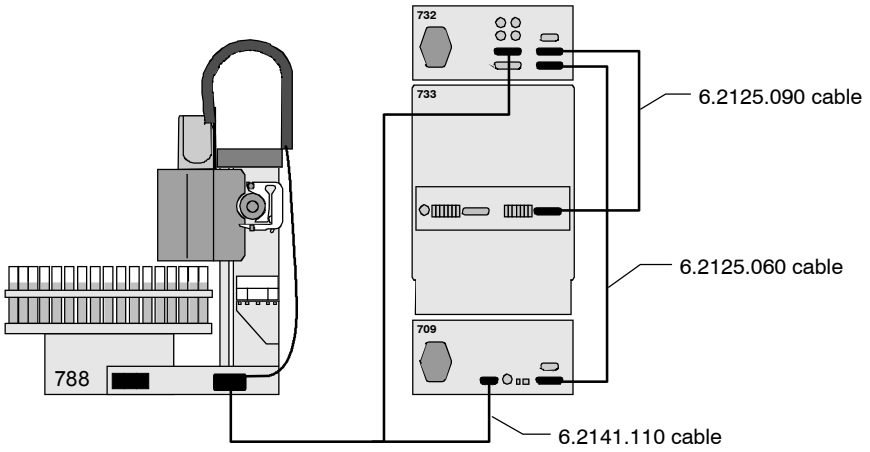


Abb. 18: Interconnection with IC system without suppression

2.6.2 IC system with suppression with 788 as "Master"

The 788 IC Filtration Sample Processor is connected to an IC system with suppression consisting of 732 IC Detector, 733 IC Separation Center, 709 IC Pump and either 752 Pump Unit or 753 Suppressor Module as shown in *Fig. 19* using the 6.2125.120 adaptor. With this interconnection, in which the 788 IC Filtration Sample Processor is the "Master", the standard methods **'SP'** and **'SP Seg'** can be used (see *section 4.6*).

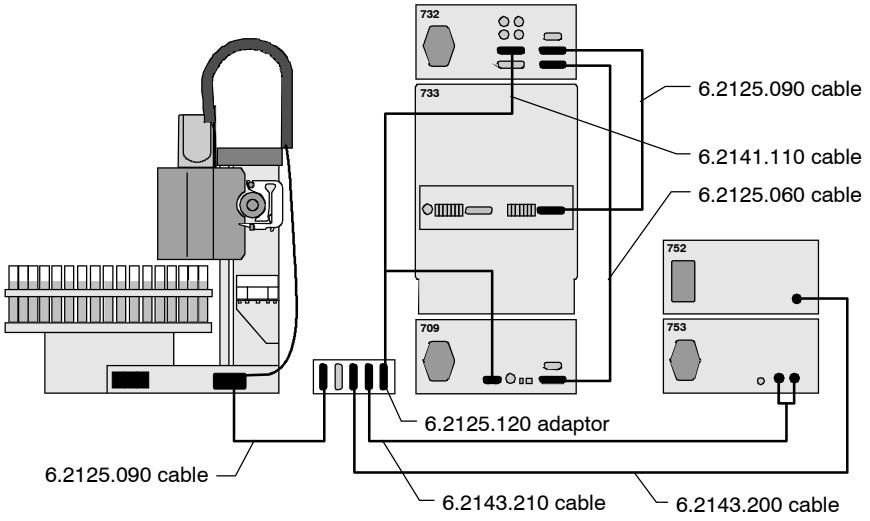


Abb. 19: Interconnection with IC system with suppression with 788 as "Master"

2.6.3 IC system with suppression with PC as "Master"

The 788 IC Filtration Sample Processor is connected to an IC system with suppression consisting of 732 IC Detector, 733 IC Separation Center, 709 IC Pump and either 752 Pump Unit or 753 Suppressor Module as shown in *Fig. 20* using the 6.2125.120 adaptor. With this interconnection, in which the PC is the "Master", the standard methods **'PC'**, **'PC Seg'** and **'Preconc'** can be used (see *section 4.6*).

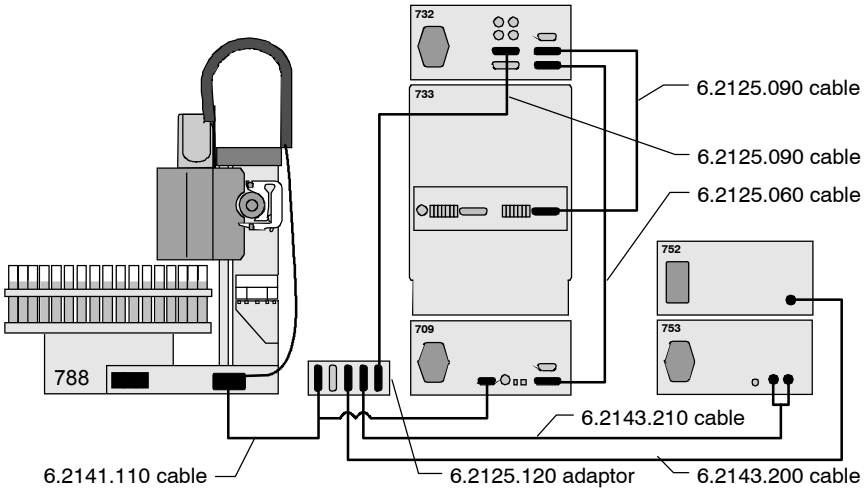


Abb. 20: Interconnection with IC system with suppression with PC as "Master"

2.6.4 IC system for simultaneous anion/cation determination

The 788 IC Filtration Sample Processor is connected to an IC system for simultaneous determination of anions and cations consisting of two 732 IC Detectors, the 733 IC Separation Center, two 709 IC Pumps and (if suppression is used) the 753 Suppressor Module as shown in *Fig. 21* using the 6.2125.120 adaptor. With this interconnection the standard methods **'AnCat'** and **'AnCatSeg'** can be used (see *section 4.6*).

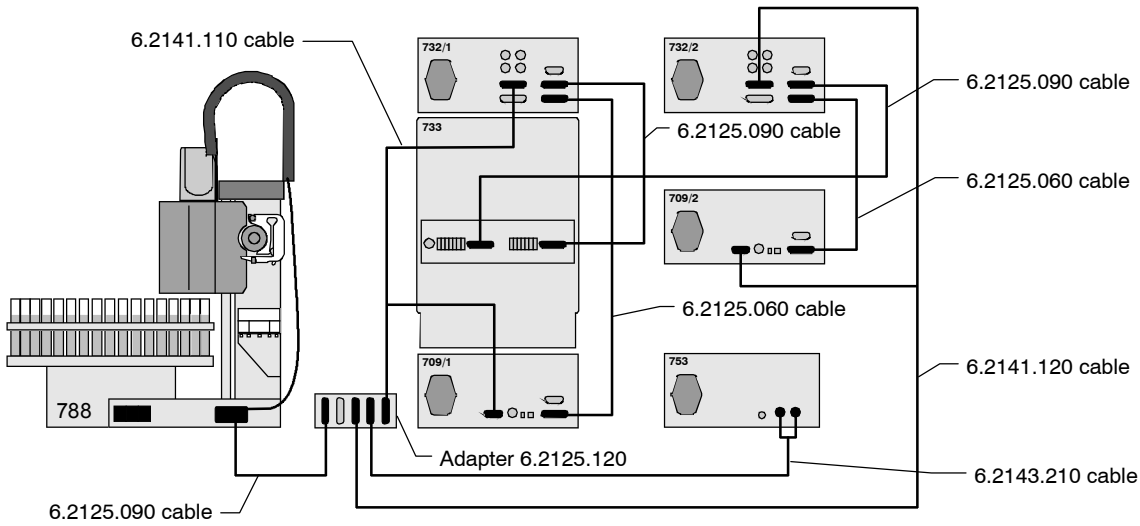


Abb. 21: Interconnection for anion/cation system

2.6.5 IC system with sample dialysis

The 788 IC Filtration Sample Processor can be connected to an IC system with sample dialysis. However, this application is not planned for usage together with the ultra-filtration cell, which should be bridged.

The sample processor is connected to the modular IC system consisting of 732 IC Detector, 733 IC Separation Center, 709 IC Pump, 754 Dialysis Unit and (if suppression is used) the 753 Suppressor Module as shown in *Fig. 22* using the 6.2125.120 adaptor. With this interconnection the standard method **'Dialysis'** can be used (see *section 4.6*). If no suppression is used, the 754 Dialysis Unit can be connected to the 6.2125.120 adaptor using the 6.2143.200 cable.

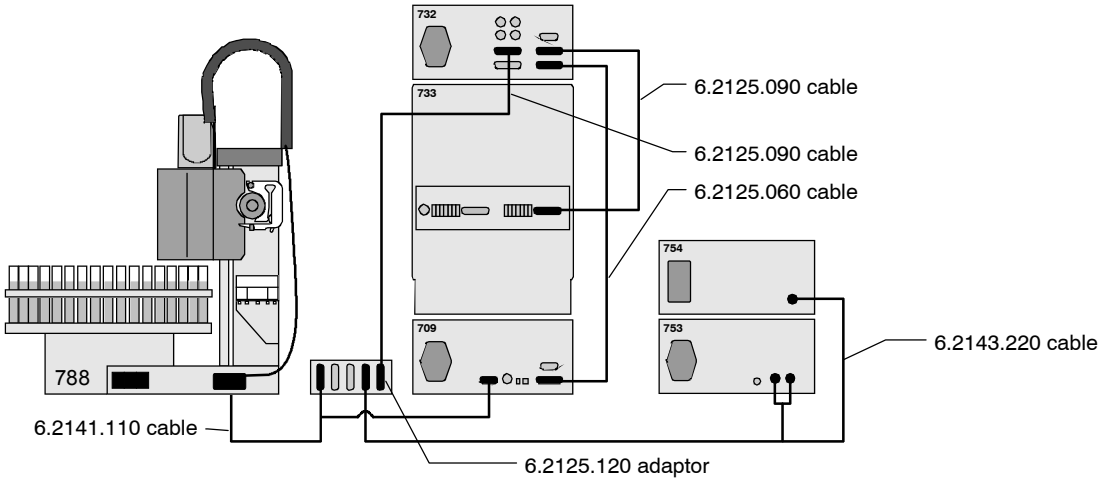


Abb. 22: Interconnection with IC system with dialysis

2.7 Connection of devices to the RS232 interface

2.7.1 General information on RS232 interface

Many different instruments may be connected via the serial RS232 interface **40**. In addition to all Metrohm instruments that support the Metrohm remote control language (see *section 5.2*) any printer with serial interface (or parallel interface and parallel/serial converter) or a personal computer (PC) may be connected. Any other measuring instrument may be controlled via RS232 interface, as long as it supports serial data transmission.

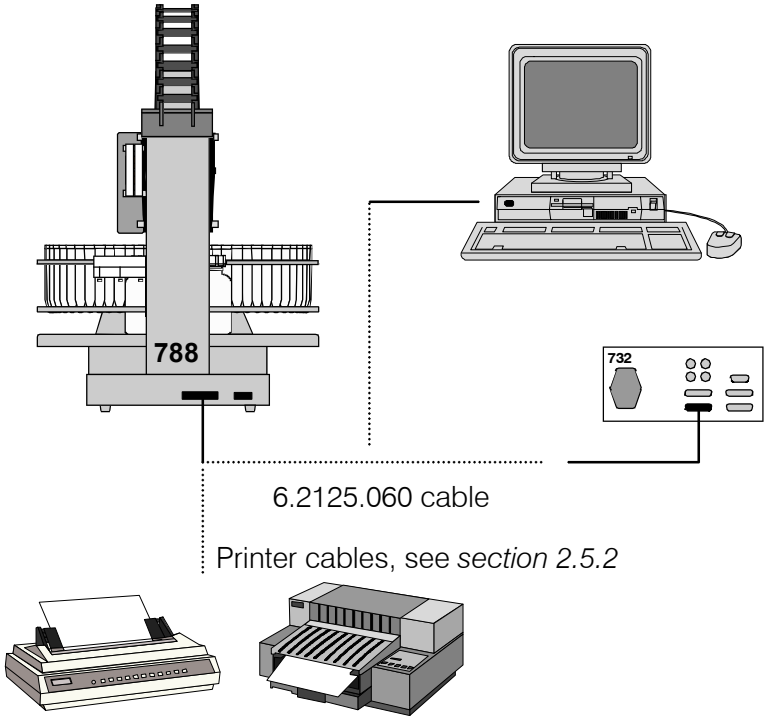


Fig. 23: Connection possibilities for the RS232 interface

In order to guarantee safe data transmission, it is important to set the same RS232 interface parameters correctly for both instruments connected (see *section 2.5.2*).

Control commands (examples)

`CTL:RS`	`&M;$G`	starts a Metrohm instrument
`CTL:RS`	`&M;$S`	stops a Metrohm instrument
`PRINT:`	`config`	prints a configuration report to a printer or PC

Scanning input data (example):

`SCN:RS :`	`*R"`	waiting for readiness of a Metrohm instrument

The settings and cables for the connection of a printer to the 788 IC Filtration Sample Processor are described in section 2.7.2.

2.7.2 Connecting a printer

Before connecting a printer to the RS232 interface, switch off the 788 IC Filtration Sample Processor !!

Printers with the following printer drivers may be connected:

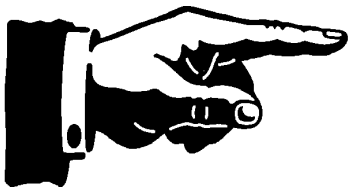
IBM	IBM Proprinter and printers with IBM emulation
Epson	Epson printers and printers with Epson emulation
Seiko	Seiko printers DPU-411 and DPU-414
Citizen	Citizen printer IDP562-RS
HP	HP printers and compatibles with HP PCL3 emulation

The interface parameters are set in the configuration submenu "**>RS232 settings**". Corresponding parameters have to be set on the printer. The following table provides information on a few selected printers.

Printer	*Cable*	*RS232 settings*	*Settings on printer*
Seiko DPU-414	6.2125.130	**baud rate: 9600** **data bit: 8** **stop bit: 1** **parity: none** **handshake: Hws** **character set: Seiko**	Settings of the DIP switches: Dip SW-1 / Dip SW-2 / Dip SW-3 1 OFF ON ON 2 ON OFF ON 3 ON ON ON 4 OFF ON ON 5 ON ON OFF 6 OFF ON ON 7 ON OFF ON 8 ON OFF ON The switchable 7-bit ASCII character set of the printer will be automatically set to the national character sets in accordance with the set dialog language.
Citizen IDP562-RS	6.2125.050	**baud rate: 9600** **data bit: 8** **stop bit: 1** **parity: none** **handshake: Hws** **character set:Citizen**	Settings of the DIP switches:  The switchable 7-bit ASCII character set of the printer can be changed to the national character sets only by setting Dip switch 4 and 5: *4* / *5* / *Character set* OFF OFF USA ON ON Great Britain ON OFF France OFF ON Germany Spanish does not have its own character set (it is best to select French).
Epson LX-300	6.2125.050	**baud rate: 9600** **data bit: 8** **stop bit: 1** **parity: none** **handshake: Hws** **character set: Epson**	see printer manual

If you connect other printers, ensure that these emulate a printer mode supported by the 788 IC Filtration Sample Processor. Please note, that some printers with a GDI-Interface do not have such printer emulation. They require a direct control by a personal computer and therefore cannot be used with a 788 IC Filtration Sample Processor.

Most printers with a serial interface are connected using the 6.2125.050 cable. Printers with a parallel interface need a serial/parallel converter (e.g. 2.145.0300) and the 6.2125.020 Cable. The RS232 settings correspond to the data given in the table above. Only the setting for the printer driver (`character set:`) has to be adapted to the connected printer or its printer emulation, respectively.



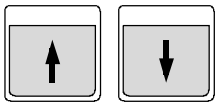
3 Operating tutorial

In order to become acquainted with the 788 IC Filtration Sample Processor and its mode of operation, it is helpful to work through the short Operating Tutorial. The basic operating steps that are required to prepare the first sample series and run it with a given method are described here.

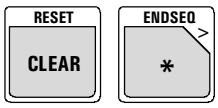
For further explanations of the operation, please refer to section 4, which describes the functions of the individual keys and the programming in detail.

3.1 Prerequisites / Preparations

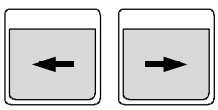
- It is assumed that the 788 IC Filtration Sample Processor is fully installed (see *section 2*). Don't forget to mount the splash protection and the plug cover.
- Connect a 732 IC Detector at the remote connection **30** (see *section 2.4*).
- Prepare the ultra-filtration cell (see *section 2.3.8*).
- Choose a simple IC method that you have saved in the 732 IC Detector or create a new simple method.



- The <↑> and <↓> keys can be used to move the lift up or down.



- Install the 6.2041.430 sample rack. Press <RESET> or <ENDSEQ> + <ENTER>. The 788 IC Filtration Sample Processor is initialized in this way with the lift and rack placed in the rest position. In this position the magnetic rack code can be read so that the internally stored rack data (position table, etc.) can be loaded. This should be done after every rack change.



- Insert some sample tubes into the sample rack, beginning with position 1. Using the keys <←> and <→> the rack can be turned for this purpose.

3.2 Configuration

CONFIG

ENTER

- The dialog language can be set in the configuration menu. Press <CONFIG>

```
configuration
>auxiliaries
```

- and then <ENTER>.

```
>auxiliaries
dialog:          english
```

TOWER SELECT

- This menu item has a colon, indicating that here the parameters can be selected from a list. Press <SELECT> several times in order to view the various selections and get used to this type of dialog.

```
>auxiliaries
dialog:          deutsch
```

- With <ENTER> you can accept the suggestion **'dialog: english'**.

```
>auxiliaries
display contrast:      3
```

4 × <↓>

- By pressing <↓> 4 times you reach the menu selection **'max. lift way'**.

```
>auxiliaries
max. lift way    125 mm
```

<ENTER>

- Here the lowest allowable lift position for automatic and manual operation can be set. For the 6.2041.430 sample rack with 6.2743.050 sample tubes, this limit value of 125 mm should not be changed. Accept the value by pressing <ENTER>.

```
configuration
>rack definitions
```

QUIT

or

STOP

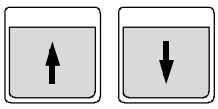
- In order to put the 788 IC Filtration Sample Processor back into the initial position, press <QUIT> or <STOP>.

```
******** counter   0/127
PUMP-               ready
```

- In the normal state, the method name and the sample counter reading are displayed in the first line. The second line serves as status line which displays the pump status and the changer status.

- At the end of this basic configuration the 788 IC Filtration Sample Processor must be turned off and on again or re-initialized by pressing <RESET> to make the latest settings effective.
- All data entered up to this point however, are retained. The same is true for any methods that may have been saved.

3.3 Rack configuration



- Using the keys <↑> and <↓> you can run the lift to the desired work position for the needle.

<↓>

<ENTER>

- Now open the configuration menu with <CONFIG> and move the cursor key <↓>, until you reach the submenu **'>rack definitions'**. Press <ENTER> to open this submenu where you can define the rack configuration.

```
>rack definitions
rack number            2
```

<ENTER>

- The rack number of the engaged rack will be displayed as soon as the sample rack has been correctly identified. By confirming with <ENTER> you access the rack data. (By entering another rack number you can also edit the data of a sample rack that is not engaged.)

<↓>

- You can skip the first entries (code and rack type) with the cursor key <↓>. Now you can enter the work position of the needle.

```
>rack definitions      2
work position     125 mm
```

- Because you have already positioned the needle at the desired height, you can accept the current lift position directly by pressing <CLEAR>. Of course the work position can be entered manually or the value that has automatically been accepted can be modified later. Lift positions are given in millimeters (0…125 mm), measured from the uppermost limit (rest position) of the lift. Consider during the input of the working position that with sample tubes sealed with non-perforated PE caps the work position must be set to 125 mm, since otherwise a vacuum can develop in the sample tube and the sample will not be aspirated correctly.

```
>rack definitions      2
work position      71 mm
```

<ENTER>

- In any case don't forget to confirm the value with <ENTER>.

```
>rack definitions      2
rinse position    125 mm
```

- The next menu item **'rinse position'** defines the height at which the lift must be when the needle is rinsed. As for the work position, the value here can also be entered manually or automatically accepted. For the latter, the configuration menu must be exited by pressing <QUIT> twice and the lift newly positioned.

```
>rack definitions      2
rinse position    105 mm
```

<ENTER>

```
>rack definitions      2
shift position      0 mm
```

- The menu item **'shift position'** defines the height of the needle when the sample rack is rotated. For the 788 IC Filtration Sample Processor this height is set to 0 mm and cannot be changed.

<ENTER>

- Press <ENTER>.

```
>rack definitions      2
special position    0 mm
```

- The **'special position'** defines a further height of the lift. For the entry proceed as for the work position.

<ENTER>

```
>rack definitions      2
special position   55 mm
```

- The final entry in the rack configuration is the definition of the position of the special beakers.

<ENTER>

```
>rack definitions      2
>>special positions
```

- In the submenu **'>>special positions'** enter the positions at which you have placed conditioning or rinsing beakers (for the 6.2041.430 sample rack the two positions **'special beaker 1 128'** and **'special beaker 2 129'** are already set).

<ENTER>

- The configuration can now be exited with <STOP> or by pressing <QUIT> three times. The rack data entered are now available at all times and must not be re-defined every time.

3.4 Methods

USER METHOD

- Now open the user method menu by pressing <USER METHOD>.

```
methods
>recall method
```

<ENTER>

- Press <ENTER> to load a predefined method.

```
>recall method
method:          ********
```

TOWER SELECT

- Choose **'SP'** with the <SELECT> key. This is a universal method with the 788 IC Filtration Sample Processor as "Master" from which you can learn the basic sample changer commands.

<ENTER>

- After you have confirmed loading the method with <ENTER>, the name of the method appears in the upper left corner of the display. You can now use the TRACE function to run the method in steps to understand how it works (see *section 3.5*).

3.5 "Tracing"

SAMPLE 7

- Before you begin tracing, set the position of the first sample with the SAMPLE command. Press <SAMPLE>.

```
manual operation
SAMPLE:     =          1
```

<2>
<ENTER>

- Press <2> and <ENTER>.

PARAM

- Now press <PARAM> to open the parameter menu. All parameters and sequences that are stored with methods can be found here.

```
parameters
number of samples:  rack
```

- The first menu entry defines the number of sample tubes (without the special beakers) that are to be treated in a series. Here you can choose between **'rack'** (= a sample rack that is partially or completely filled, only positions with a sample tube are counted) and **'*'** (= infinite number of samples) with <SELECT>. However for this learning sequence, enter **'3'** on the keyboard. It is also possible here, as with the other parameters, to enter data manually or use the "select" choice.

<3>
<ENTER>

<ENTER>

```
parameters
>start sequence
```

- In the submenu **'>start sequence'** the commands that are executed at the start of a sample series are found.

```
>start sequence
 1 CTL:Rm:          INIT
```

- The first command is a CTL command for the initialization of the remote interface. This command should be used in the start sequence of every method. Do not change anything here and press <↓>.

<↓>

```
>start sequence
 2 CTL:Rm:   PUMP 752 ON
```

- With the second CTL command the 752 Pump Unit used for the operation of the suppressor is started. If you use a suppressor and the 752 Pump Unit is connected to the remote interface of the 788 IC Filtration Sample Processor, press <START>. The 752 Pump Unit is started.

START

- Leave this submenu with <QUIT>.

<QUIT>

<↓>

- In the submenu **'>sample sequence'** you find the command sequences that are executed for every sample. It is recommended to test out this procedure line by line with the TRACE function.

<ENTER>

```
>sample sequence
 1 SCN:Rm      : Pump1 ?
```

- In the first line the SCAN command is used to scan the status of the 709 IC Pump. The 788 IC Filtration Sample Processor waits until the pump drive of the 709 IC Pump is switched on. Therefore switch on the pump drive at the 709 IC Pump. If you press <START> at this point, this command is executed and the next program line appears.

START

```
>sample sequence
 2 MOVE  1     :  sample
```

- Press <START> to place the sample tube in the position predefined as sample position 2 below the needle.

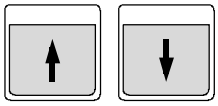
<START>

```
>sample sequence
 3 LIFT: 1  :    work mm
```

- On the next line press <START> again to move the needle into the work position you previously defined for this rack.

<START>

- With this command you can become acquainted with the LEARN mode. It allows the user to manually set the parameters of a command on a trial basis.



<ENTER>

- Press <LEARN> to access the LEARN mode. The blinking LEARN-LED indicates that the 788 IC Filtration Sample Processor is ready to execute the command.
- Now move the lift into the desired position with the <↓> and <↑> keys. You will notice that the current lift position is always indicated "live". During execution of the command the LEARN-LED is lit continuously. Accept the lift position that has been set by pressing <ENTER> and thereby exit the LEARN mode. The LEARN LED goes off again.

```
>sample sequence
 4 CTL:Rm:      FILL A 1
```

<START>

- In this line the injection valve at the 733 IC Separation Center is switched to the "Fill" position.

```
>sample sequence
 5 PUMP  1.1    :  240 s
```

<START>

- In this line the peristaltic pump at the 788 IC Filtration Sample Processor is started in order to convey the sample from the sample tube to the sample loop at the 733 IC Separation Center.

- Here, you can use the LEARN mode to optimize the pump time too.
- In this case, as with the other "teachable" commands (the LIFT command is an exception), pressing the <LEARN> key causes immediate execution of the corresponding command. The elapsed time is also displayed here "live". By pressing the <LEARN> key again the command can be interrupted.
- The blinking LED indicates that the 788 IC Filtration Sample Processor is still in the LEARN mode. If you now switch the pump back on with the <LEARN> key, you will see that the "live" value (pump time) is now added to the existing value.

<ENTER>

- Now set the pump time in this way. Accept the total time with <ENTER> and exit the LEARN mode in this way.

```
>sample sequence
 6 CTL:Rm:        ZERO 1
```

<START>

- In this line the autozero function at the 732 IC Detector is triggered.

```
>sample sequence
 7 CTL:Rm:    INJECT A 1
```

<START>

- In this line the injection valve at the 733 IC Separation Center is switched to the "Inject" position.

```
>sample sequence
 8 WAIT          1200 s
```

- In this line a waiting time is defined that is used for the acquisition of the chromatogram.
- The LEARN mode can also be used with the WAIT command.

<ENTER>

```
>sample sequence
 9 NOP
```

- An empty line with a **'NOP'**-entry (no operation) always forms the end of a sequence.
- Exit the sample sequence with <QUIT> and go to the final sequence.

<QUIT>
<↓>
<ENTER>

- After all sample tubes have been processed, the final sequence is executed.

```
>final sequence
 1 CTL:Rm:    PUMP R/S 1
```

- In this line the pump drive at the 709 IC Pump is switched off. Press <START>.

START

```
>final sequence
 2 CTL:Rm:  PUMP 752 OFF
```

- In this line the pump drive at the 752 Pump Unit is switched off. Press <START>.

START

```
>final sequence
 3 NOP
```

- Now you have reached the end of the final sequence and have completed the entire run of a sample series.
- By pressing <QUIT> twice the 788 IC Filtration Sample Processor returns to the normal state.

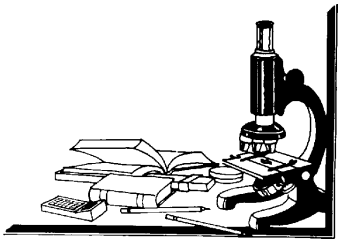
QUIT

- Now prepare some sample tubes and place them on the sample rack. Prepare the IC system with 732 IC Detector, 733 IC Separation Center, 709 IC Pump and 752 Pump Unit for the recording of chromatograms.
- Enter the number of samples to be processed (<PARAM>) and define the position of the first sample (SAMPLE = 1).

PARAM SAMPLE 7

START

- Now you can start your first sample series with <START>.



4 Operation

This section provides a detailed description of the operation of the 788 IC Filtration Sample Processor using the keyboard and dialog display. The overview of the fundamentals of operation and key functions (section 4.1) is followed by a detailed description of configuration settings (section 4.2), methods (section 4.3), manual operation (section 4.4), sample racks (section 4.5), standard methods (section 4.6), and filtration principles (section 4.7).

4.1 Fundamentals of operation

4.1.1 Display

The display on the 6.2142.010 keyboard consists of two lines, each having 24 characters.

The first line serves as a title line in which the current method and the sample counter reading are displayed. In the edit mode the menu title is shown.

The second line serves as a status line which displays specific activities depending on the operating state. In the edit mode it serves as an entry line.

Normal State

Sample counter ↓

Method name →
Pump status →

```
******** counter   1/127
PUMP-             ready
```

← Changer status

Method processing

Sample counter ↓

Method name →
Running sequence →

```
******** counter   2/127
START   03 WAIT    11 s
```

← Parameter

↑ Current command with line number

Edit mode

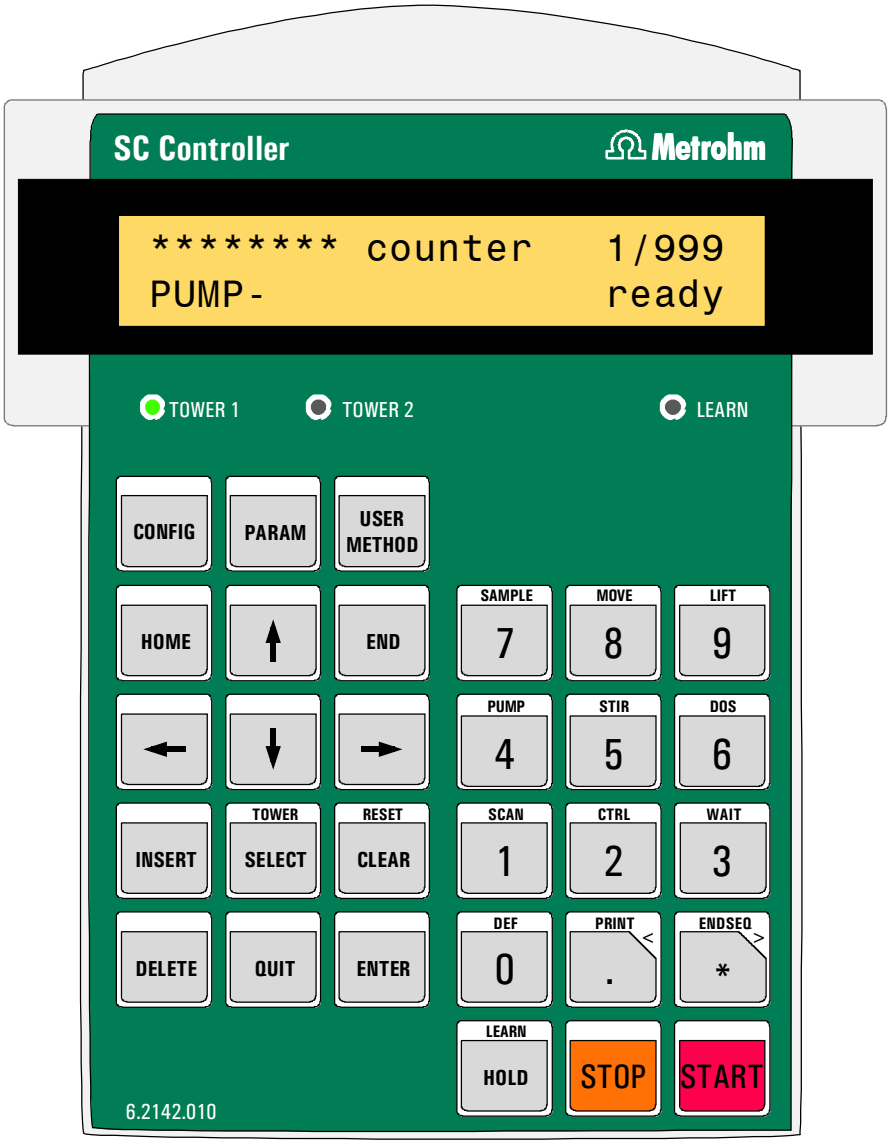
Menu title →
Menu line/command →

```
>sample sequence
 1 MOVE  1     :  sample
```

← 2nd Parameter

↑ 1st Parameter

4.1.2 Keyboard



Most of the keys have two functions according to whether the 788 IC Filtration Sample Processor is in the normal state or in the edit mode.

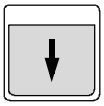
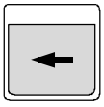
The uppermost row contains the keys which make the menus accessible (<CONFIG>, <PARAM>, <USER METHOD>). Here with the help of the keys on the left side of the keyboard, you can navigate and change parameters. For the latter, the numerical keypad on the right half of the keyboard is available. Except for the menu **'methods'** the entries under these selection menus can be altered while a method is in process and for the most part, have an immediate effect on the procedure which is running.

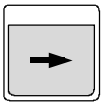
The lowermost row of keys (<HOLD>, <STOP>, <START>) is used for the direct control of method processing.

Except for editing '5' and '6' the keys <5/STIR> and <6/DOS> don't have any additional functions with this instrument.

4.1.3 Overview of key functions

Key	*Normal state*	*Edit mode*
CONFIG	**Open the configuration menu** • The <CONFIG> key opens the selection menu for the configuration of the 788 IC Filtration Sample Processor . • The settings in the configuration menu remain constant until they are changed or the working memory (RAM) for the configuration settings is re-initialized.	**Select configuration settings** • When the configuration menu is open, pressing the <CONFIG> key displays the next menu line. • After the last line is displayed, the first one follows. • <QUIT> exits the menu.
PARAM	**Open the parameter menu** • The <PARAM> key opens the selection menu for the changer settings. • All settings that are set in the parameter menu belong to a method and will be saved with the method. These parameters are method-specific.	**Select method parameters** • When the parameter menu is open, pressing the <PARAM> key displays the next menu line. • After the last line is displayed, the first one follows. • <QUIT> exits the menu.
USER METHOD	**Open the user method menu** • The <USER METHOD> key opens the selection menu for the loading, saving and deletion of user-defined methods.	**Select method functions** • When the user method menu is open, pressing the <USER METHOD> key displays the next menu line. • After the last line is displayed, the first one follows. • <QUIT> exits the menu.
HOME	**Bring lift to zero-position** • The <HOME> key runs the lift with the needle to the zero-position (0 mm), i.e. to the upper stop.	**Select the first line of a menu** • With the <HOME> key, the first line in a menu or a sequence can be accessed. • Any data that has been altered in a menu or command line is not carried over (see <ENTER> key).

Key	*Normal state*	*Edit mode*
	**Lift in work position** • The <END> key runs the lift into the work position. • The work position is defined separately for every sample rack in the configuration menu under `'>rack definitions'` (in mm from the rest position, i.e. as measured from the upper stop).	**Select the last line of a menu** • With the <END> key, the last line in a menu or a sequence can be accessed. • Any data that has been altered in a menu or command line is not carried over (see <ENTER> key).
	**Run lift upwards** • Run lift upwards. The lift movement is executed as long as the key remains pressed.	**Select previous menu line** • In a Select menu or a sequence the <↑> key accesses the previous line. • Any data that has been altered in a menu or command line is not carried over (see <ENTER> key).
	**Run lift downwards** • Run lift downwards. The lift movement is executed as long as the key remains pressed.	**Select next menu line** • In a Select Menu or a sequence the <↓> key accesses the next line. • Any data that has been altered in a menu or command line is not carried over (see <ENTER> key).
	**Turn rack left** • The <←> key turns the sample rack one position to the left, i.e. in the counterclockwise direction. The next highest beaker position is placed under the needle. • The turning speed of the rack can be defined in the Parameter menu. • The rotation of the rack can only be carried out when the lift is at or above the shift position.	**Move the cursor one column to the left** • With the <←> key the cursor is moved one column to the left in an edit line with two parameters. • Any altered data will not be carried over during this action (see <ENTER> key).

Key	*Normal state*	*Edit mode*
	**Turn rack right** • The <➔> key turns the sample rack one position to the right, i.e. in the clockwise direction. The next lowest beaker position is placed under the needle. • The turning speed of the rack can be defined in the Parameter menu. • The rotation of the rack can only be carried out when the lift is at or above the shift position.	**Move the cursor one column to the right** • With the <➔> key the cursor is moved one column to the right in an editing line with two parameters. • Any data which has been altered will not be carried over during this action (see <ENTER> key).
		**Add a command line to a sequence** • Adds a new command line **above the current line** in a sequence. The **NOP** command (no operation) automatically occupies this line and has no function. • The lines following this line are shifted one line downwards.
		**Delete a command line in a sequence** • Deletes the current line in a sequence. • The lines which follow shift upwards by one line.
		**Select parameter** • With the <SELECT> key given data values can be selected for a particular parameter in manual operation. • With every repeated keystroke the next value that can be selected is displayed. The last value is followed again by the first. • The data is accepted with <ENTER>.

Key	Normal state	Edit mode
	**Initialization of the 788 IC Filtration Sample Processor** • The <RESET> key serves to initialize the IC Sample Processor. • A method in the working memory remains unchanged. The sample rack and the lift return to their initial positions in this case. **Interruption of a method after the current sequence** • During processing of a method, the sample series can be aborted with <CLEAR> so that the sample currently being processed is processed to completion. The final sequence is not executed in this case.	**Deleting parameters, setting the default values** • The <CLEAR> key sets the initial (default) value given for a parameter. **Delete last character** • In text edit mode the last character will be deleted with <CLEAR> (Backspace).
	**Aborting a command already in operation** • When a sequence is being processed the currently running command will be aborted and continued in the course of the next command line. This is useful when a programmed waiting time should be shortened or when a signal cannot be recorded with a SCAN command. **Quitting error message** • With the <QUIT> key error messages can be acknowledged. Before acknowledging error messages, the cause should be remedied. • The command during which the error message occurs will nevertheless be carried out (during manual operation). • If an error occurs during method processing the error message is acknowledged by pressing the <QUIT> key and the method is interrupted (HOLD status). Afterwards <START> can be used to continue with the following command line or <STOP> will halt processing.	**Abort entry, select next highest menu level** • With the <QUIT> key the active (sub)menu or a menu or command line is exited. The next highest menu level or the basic state is selected. • Any data from a menu or command line which has been changed will not be taken over in this case. This will be signaled by an acoustic signal (see <ENTER> key). • <QUIT> acknowledges error messages.

Key	*Normal state*	*Edit mode*
ENTER		**Accept data, next line** • The <ENTER> key accepts the value entered and selects the next menu line. • A modification of data or parameters must **always** be confirmed by <ENTER>, otherwise the change will not be accepted. • If a change in a parameter is not confirmed by <ENTER> and another menu line is accessed, the previous value will be retained. This is indicated by an acoustic signal.
SAMPLE 7	**Set sample position** • The <SAMPLE> key serves to set the current sample position. • When starting a method, this position is assumed to have the first sample of a series. • If the current sample position is not manually set before the start of a sample series, rack position 1 is always started first.	**Numerical entry ('7')** or **Set sample position** • In a start sequence the SAMPLE command serves to define the first sample of a sample series. • If no SAMPLE definition is made in any sequence, the manually set rack position is assumed to be the first sample.
MOVE 8	**Position sample tube** • Turn the sample rack to position the described sample tube under the needle. In addition to the predefined sample tubes, the eight rack-specific special beakers available can be placed. Absolute positions can also be chosen. • The turning speed can be altered in the Parameter menu.	**Numerical entry ('8')** or **Position sample tube** • Turning the sample rack to position the described sample tube under the needle. In addition to the predefined sample tubes, the 8 rack specific special beakers available can also be placed. Absolute positions can also be chosen. • The turning speed can be altered in the Parameter menu.

Key	Normal state	Edit mode
LIFT 9	**Positioning the lift** • Raises or lowers the lift to a predefined position. These positions (work position, rinse position, shift position, special position) can be defined in the Configuration menu as rack-specific. • An absolute lift position in mm can also be given.	**Numerical entry ('9')** or **Positioning the lift** • The lift can be run to the predefined positions (work position, rinse position, shift position, special position) in a sequence. • An absolute lift position in mm can also be given.
PUMP 4	**Control pump** • The <PUMP> key is used to switch the peristaltic pump of the 788 IC Filtration Sample Processor on or off. • The state of the pump is shown in the second display line in the normal state. **'PUMP+'** means "switched on", **'PUMP–'** means "switched off").	**Numerical entry ('4')** or **Control pump** • The pump can be specifically switched on and off in a sequence or set to operate for a fixed amount of time (in seconds).
SCAN 1	**Display input signals** • Display of the incoming signal or data on the remote or RS interface. This function serves to control the data communication or states of connected instruments. • The first parameter represents the interface selection. The signals for data being received at that moment are displayed as the second parameter. • If the parallel remote interface (**Rm**) is selected, the signal states of the incoming remote lines are displayed in binary form (**1** = line active, **0** = line inactive). Details see *section 5.1*. • If the serial RS232 interface (**RS**) is selected, the character string being received is displayed line by line (14 characters). Details see *section 5.2*.	**Numerical entry ('1')** or **Scan input signals** • In a sequence the SCAN command causes method processing to stop until the predefined bit pattern (with the remote interface) or the given character string (with the RS232 interface) is received. • Predefined bit patterns are available for the remote interface and can be selected via simple short-names (e.g. **'Ready 1'** or **'End 2'**). • Character strings consisting of 14 ASCII characters may be defined with the RS232 interface.

Key	*Normal state*	*Edit mode*
CTRL 2	**Interface control** • Controlling of external instruments via the remote and RS232 interface. This function is used for data communication with or control of connected instruments. • The first parameter stands for the selection of the interface. The second parameter defines the state of the remote output lines or data to be transmitted via RS232 interface. **Parameters for remote interface** • Bit pattern with 14 digits (**0**, **1** or *****) for the 14 output lines or predefined patterns accessible by the <SELECT> key (**'INIT 732'**, **'FILL A 1'**, etc.). **Parameters for RS232 interface** • Character string with up to 14 alphanumerical characters. Default value: **'&D.S"9"'**, may be set with <CLEAR>. Most Metrohm instruments can be controlled with such remote control commands, see *section 5.2*.	**Numerical entry ('2')** or **Interface control** • Setting the 14 signal lines of the remote interface or sending a character string via the RS232 interface to control instruments connected. • Predefined bit patterns are available for the remote interface and can be selected via simple short-names (e.g. **'INIT 732'** or **'FILL A 1'**). • Character strings consisting of 14 ASCII characters may be defined with the RS232 interface.
WAIT 3		**Numerical entry ('3')** or **Define waiting time** • Waiting for a certain time interval to elapse in a sequence.
DEF 0		**Numerical entry ('0')**
PRINT < .	**Print report** • The <PRINT> key serves for the manual printout of reports. • The choice of printer type and the parameters of the RS232 interface must be done in the Configuration menu under **'>RS232 settings'**.	**Numerical entry ('.')** **Text entry** • In a menu or sequence line in which entry of text is required, (e.g. method name), text edit mode is activated with "<". • Existing text is deleted in this event and the text cursor is set on the left margin of the text field.

Key	Normal state	Edit mode
		• "<" serves also for shifting the chain of characters to chose from, i.e. the text cursor is shifted one place to the left for each instance (see *section 4.1.6*).
	**Initialization** • The 788 IC Filtration Sample Processor is initialized with the <ENDSEQ> key followed by <ENTER>. • A method in the working memory remains unchanged. The rack and the lift are run to the initial position.	**Text entry** • In a menu or sequence line in which entry of text is required, (e.g. method name), text edit mode is activated with ">". Existing text remains in this event and the text cursor is set at the end of the existing character string. • ">" serves also for shifting the chain of characters to chose from, i.e. the text cursor is shifted one place to the right for each instance (see *section 4.1.6*). **Set end mark** • For test purposes an <ENDSEQ> command can be placed at any line desired in a sequence. This has the effect that the sequence is only executed up to this end mark.
	**Start a method** • The <START> key starts a method. Starting is only possible when the IC Sample Processor is in the normal state, i.e. when `'ready'` is shown in the display. • When starting a sample series, the sample counter is set to 0. • When <START> is pressed after an interruption (<HOLD>), the sequence is continued with the next command line.	**Trace function** • During editing of a sequence, the command defined in the command line can be directly executed with the <START> key. • A sequence can therefore be tested from start to finish (or in parts) in single steps ("tracing").

Key	*Normal state*	*Edit mode*
	**Stop process and peripheral instruments** • The <STOP> key terminates a method. • Any peripheral instruments that are connected (e.g. 709 IC Pump) are not automatically stopped. In **'>manual stop options'**, a sub-menu of the Parameter menu, you can specify what signal or data is to be transmitted via the interface involved (remote or RS232) during manual activation of the <STOP> key. The connected instrument can be halted or if necessary, initialized (see *section 4.3.2*). • During a manual halt of a sample series with <STOP>, the end sequence of the method will not be executed. • In the normal state the <STOP> key also stops the pump. The **'>manual stop options'** for connected peripheral instruments are also effective in the normal state.	**Stop editing** • <STOP> causes the editing to abort and the instrument to return to the normal state. (exception: Process sequences).
	**Interrupt Process** • The <HOLD> key interrupts the processing of a method. However connected peripheral instruments (e.g. 709 IC Pump) are not halted. Only method processing is interrupted. In the "HOLD" state a method can be completely halted with <STOP> or continued with the next command in line by pressing <START>. • After quitting an error message during method processing the IC Filtration Sample Processor automatically goes into the "HOLD" state.	**Switch on LEARN mode** • The <LEARN> key serves to start the LEARN mode. This mode is provided for easier editing of process sequences. It allows direct acceptance of a parameter value that has been set by manual control. The LEARN mode is available for the following commands: **LIFT, PUMP, SCN, WAIT** • Details concerning the LEARN mode see *section 4.3.4*.

4.1.4 Instrument dialog

The instrument dialog of the 788 IC Filtration Sample Processor is organized in the form of so-called rolling inquiries which are arranged in menu levels in a hierarchical manner and are subject to the following rules:

Main menu

The function keys <CONFIG>, <PARAM> and <USER METHOD> of the 788 IC Filtration Sample Processor open a main menu whose thematically arranged submenus are selected by repeated pressing of this key or with <↓>. The name of the key always appears in the top line of the display.

Submenu

Each submenu has a title marked by ">" which appears in the bottom line of the display. <ENTER> is used to move from the title to the individual inquiries, which are used to change the most important settings of the instrument. The top line of the display always shows the title of the active submenu.

Navigating within the menus is accomplished with the cursor keys; <HOME> jumps to the first, <END> to the last menu line.

<QUIT> exits the active menu, opens the next highest menu level or returns to the normal state.

<ENTER> either opens a submenu or confirms data entry at the lowermost menu level.

Inquiries

In inquiries without ":", the values must be entered using the numeric keys. <ENTER> is used to accept the inputted value and the next inquiry appears.

In the case of inquiries with ":", the admissible values can be selected with the <SELECT> key>. <ENTER> is used to accept the set value and the next inquiry appears.

Depending on the parameter, <CLEAR> is used to reset the displayed value to the smallest possible value or the default value. The <CLEAR> key also serves to abort wrong entries.

<QUIT> is used to quit the inquiries and return to the main menu.

You will find a schematic representation of the instrument dialog in *Fig. 24*.

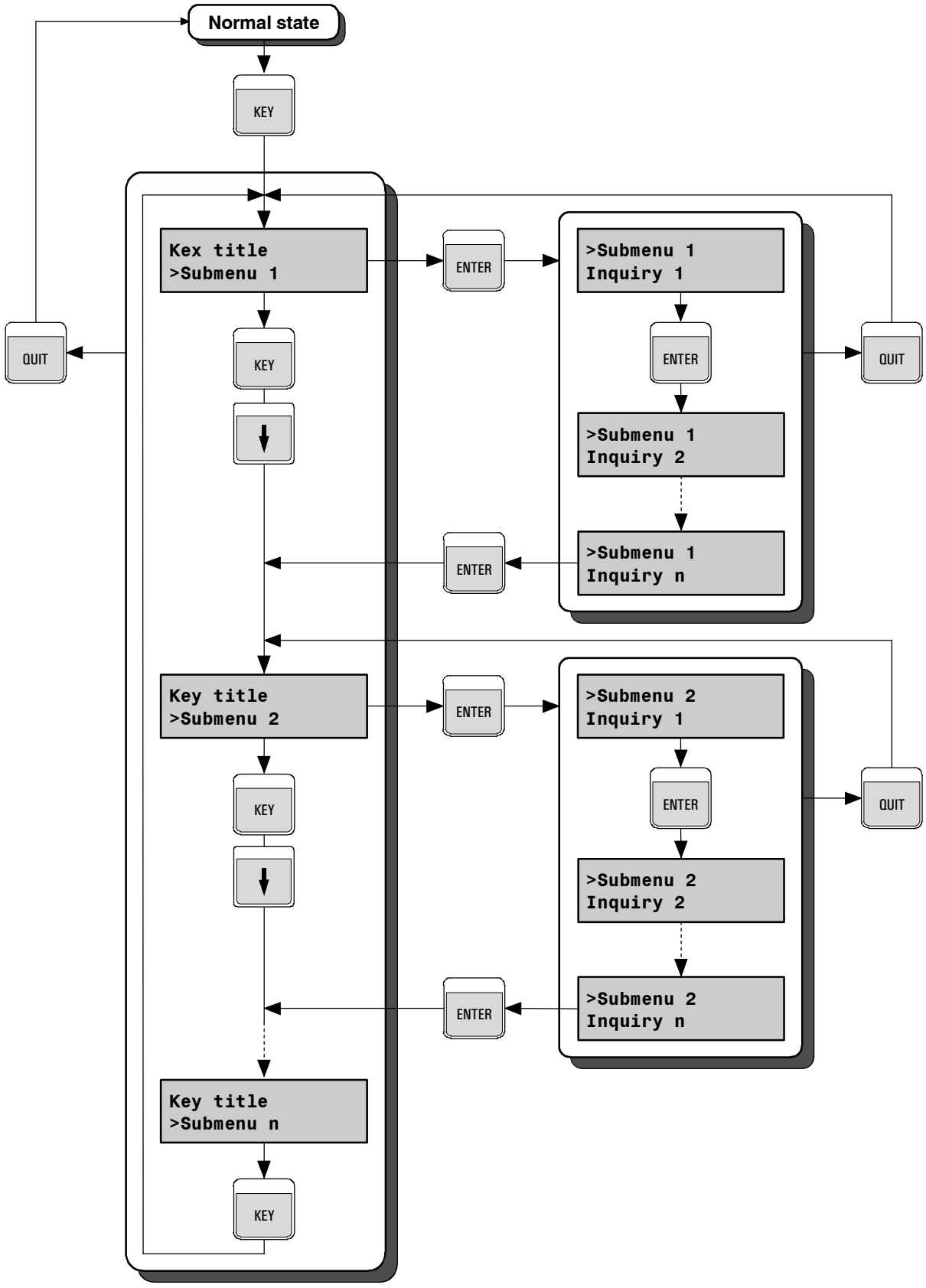
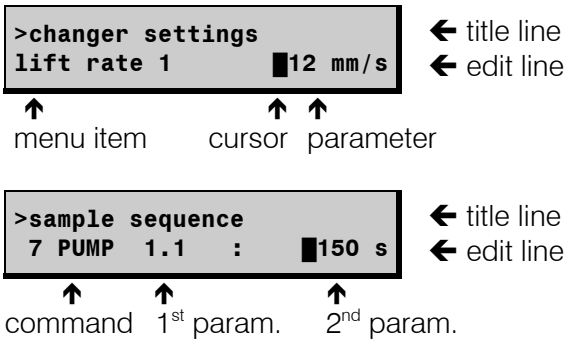


Fig. 24: Schematic representation of the instrument dialog

4.1.5 Data entry

Edit line

In a menu line or a sequence one or two parameters respectively can be entered. A blinking block cursor indicates where a parameter can be entered.

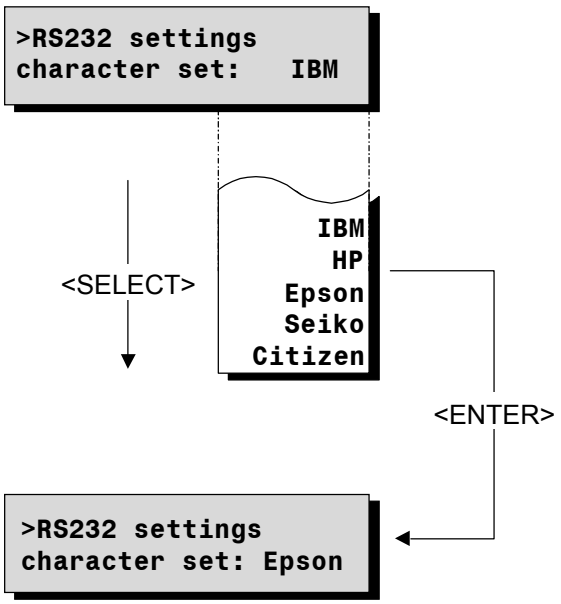


The cursor keys<➔> and <🡐> can be used to switch between the parameters. Pressing <ENTER> shifts the cursor automatically to the right, pressing <QUIT> correspondingly to the left.

<Select> choices (Roll-up selection)

Data can usually be entered directly via the numerical keypad block on the keyboard. Pressing <SELECT> at entries which are specially identified by a colon displays a preset selection of data. This selection is cyclic, structured like a revolving drum.

Example:

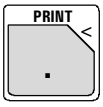


4.1.6 Text entry

The text editor can be used when text entry is provided.

Numbers can be entered directly via the keyboard.

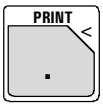
Opening the text editor



The keys "<" or ">" open the text editor. With "<" an existing character string is deleted and the text cursor is set to the left margin of the edit line. With ">" an existing character string remains and the text cursor is set on the last character of the existing text.

A character chain is displayed that is composed of all the characters in alphabetical order that can be entered. The blinking character is the currently selected one (text cursor).

Character selection



The keys "<" and ">" move the character chain composed of all possible characters (capital and small letters, numbers and special characters, in alphabetical order) in the desired direction underneath the text cursor. Pressing these keys once has the effect that the character chain is shifted one position left or right. The character chain can be shifted quickly by pressing the keys longer.

Confirmation of the character selection

The <ENTER> key causes the character that is currently positioned at the text cursor to be appended to the existing text. When the entire width of the edit line is filled, text edit mode is left and the text is accepted with <ENTER>.

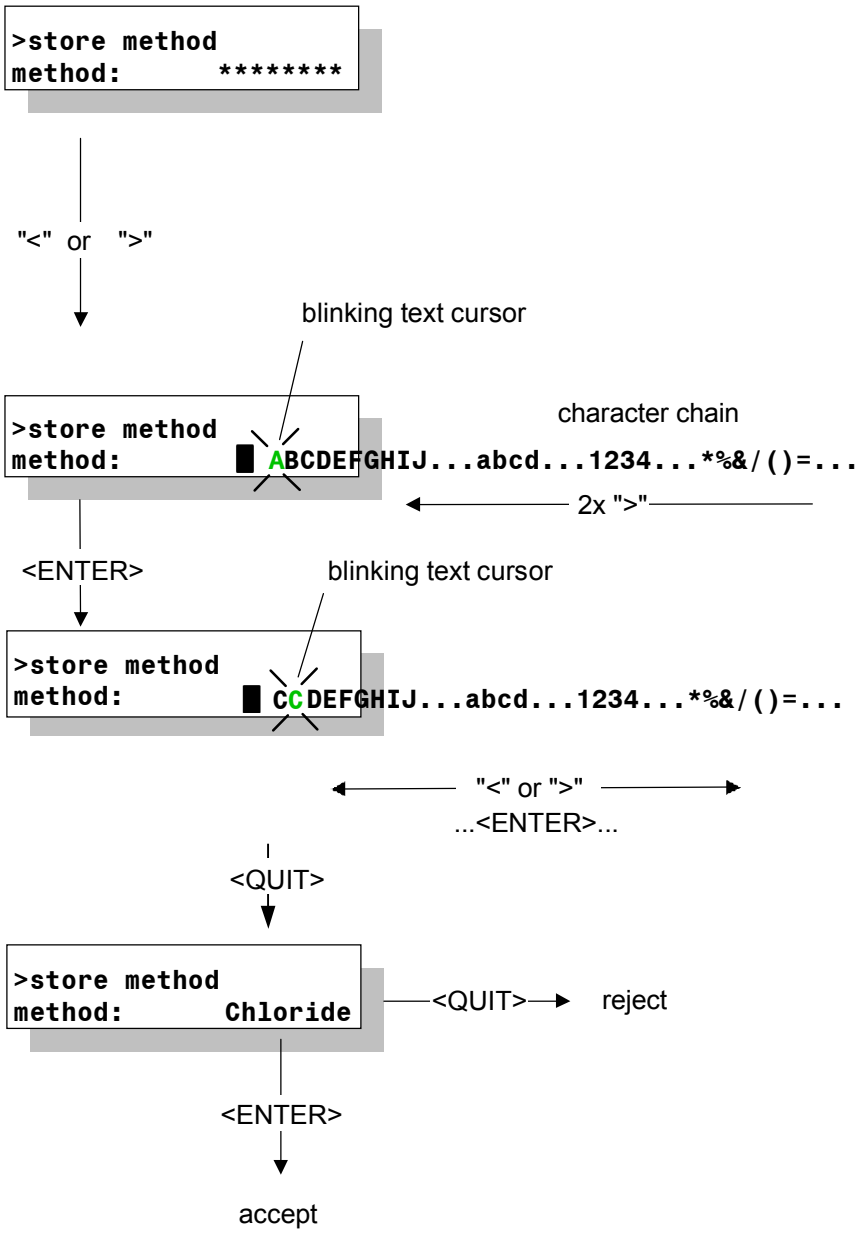
Delete character

The <CLEAR> key deletes the last character of the existing text line. The text cursor automatically shifts one character to the left.

Exit text entry

With <QUIT> the text edit mode is exited. The text line displayed can be accepted with <ENTER> or rejected by pressing <QUIT> a second time.

Scheme



An entire text line can be entered in this way, for example, for the naming of a method. Text editing can be ended with <QUIT>. The text line will be displayed in its entirety and can be accepted with <ENTER> or rejected with <QUIT>.

4.2 Basic settings

4.2.1 Configuration – <CONFIG> key

The <CONFIG> key is used for the entry of basic settings of general applicability. If you have changed the configuration, press <RESET> or switch on and off the instrument to make the entries effective. The <CONFIG> key opens the following main menu:

`configuration` `>auxiliaries`	**Various general instrument settings**
`configuration` `>rack definitions`	**Sample rack settings**
`configuration` `>RS232 settings`	**Settings for RS232 interface**

Repeated pressing of the <CONFIG> key selects the submenus in turn. Use <↓> or <↑> to move up or down one menu item; use <HOME> or <END> to move to the first or last menu item respectively. The submenu is opened with <ENTER>, <QUIT> returns to the normal state. The following listings show all dialog items which appear under <CONFIG>. The values shown in the display are the default values, the possible entry values or ranges are shown below the display.

`configuration`
`>auxiliaries`

General instrument settings

`>auxiliaries`
`dialog: english`

`english,deutsch,`
`français,español`

Dialog language

english	English
`deutsch`	German
`français`	French
`español`	Spanish

`>auxiliaries`
`display contrast 3`

`0...7`

Display contrast

`0` = large contrast

`7` = weak contrast

```
>auxiliaries
beeper:                ON
```

ON,OFF

Acoustic warning signal

ON	Acoustic warning signal in case of error messages
OFF	No warning signal

```
>auxiliaries
device label
```

8 ASCII characters

Device label

Freely selectable ASCII character string for characterizing the instrument (text entry, see *section 4.1.6).*

```
>auxiliaries
program       5.788.0010
```

read only

Number of the program version

Display only (no entry possibility).

Please specify this number in inquiries to Metrohm.

```
>auxiliaries
max. lift way      125 mm
```

0...125 mm

Maximum stroke path for needle

The following entry becomes effective after a RESET or switching the IC Sample Processor off and on again.

This setting for max. lift way is **important** for safe operation. If the value for this entry is correct, damage to the needle can be avoided because this prevents the needle from being driven lower than the position indicated. If you use the 6.2041.430 sample rack with 6.2743.050 sample tubes, the default value of 125 mm should be retained.

Pressing <CLEAR> directly accepts the current lift position of the active tower.

```
configuration
>rack definitions
```

Definition of sample racks

```
>rack definitions
rack number            2
```

1...16

Number of the rack

The number of the rack in position is automatically displayed here, when its configuration is already stored and when a RESET has been performed. If the configuration of another rack must be changed, its rack number must be entered and confirmed with <ENTER>. The rack number will be shown in the first menu line for the subsequent entries. For more information concerning sample racks, see *section 4.5*. The number **2** is assigned to the 6.2041.430 sample rack delivered.

```
>rack definitions      2
code               010001
```

6 bits

Identification code of the rack

The rack code must be unique and can only occur once in the instrument (see *section 4.5*).

```
>rack definitions      2
type:             M129-2
```

M129-2...

Type description of the rack

<SELECT> enables the choice of Metrohm-specific and self-defined rack types (see *section 4.5*).

```
>rack definitions      2
work position     125 mm
```

0...125 mm

Working position of the needle

in mm from the upper stop.

Pressing <CLEAR> directly accepts the current lift position.

```
>rack definitions      2
rinse position    125 mm
```

0...125 mm

Rinsing position of the needle

in mm from the upper stop.

Pressing <CLEAR> directly accepts the current lift position.

```
>rack definitions      2
shift position      0 mm
```

0 mm

Shifting position of the needle

in mm from the upper stop.

Only the value **'0'** is permissible.

```
>rack definitions      2
special position    0 mm
```

0...125 mm

Special position of the needle

in mm from the upper stop.

Pressing <CLEAR> directly accepts the current lift position.

```
>rack definitions      2
>>special positions
```

Submenu

Special positions submenu

```
>>special positions
special beaker 1     128
```

0...number of positions

Position of special beaker 1

```
>>special positions
special beaker 2     129
```

0...number of positions

Position of special beaker 2

etc. up to special beaker 8

Up to 8 special beaker positions can be defined (see *section 4.5*).

```
configuration
>RS232 settings
```

Settings for RS232 interface

For further details on the RS232 interface, see *section 5.2.*

```
>RS232 settings
baud rate:          9600
```

9600,4800,2400,
1200,600,300

Data transmission rate (baud rate)

Data transmission rate in bit/s

```
>RS232 settings
data bit:             8
```

7,8

Data bits

```
>RS232 settings
stop bit:             1
```

1,2

Stop bits

```
>RS232 settings
parity:            none
```

none,odd,even

Parity

`none`	Parity is not checked.
`odd`	Odd parity.
`even`	Even parity.

```
>RS232 settings
handshake:          HWs
```

HWs,HWf,
SWchar,SWline,none

Handshake

`HWs`	Reduced hardware handshake.
`HWf`	Full hardware handshake.
`SWchar`	Software handshake with character stop.
`SWline`	Software handshake with line stop.
`none`	No handshake.

For detailed information on the handshake, see *section 5.2.8.*

```
>RS232 settings
character set:      IBM
```

IBM,HP,Epson,
Seiko,Citizen

Character set for printer or PC

The settings for the printers recommended by Metrohm are listed in *section 2.7.2*. For printers not listed, the setting **`'Epson'`** is recommended. In any case the printer handbook should be consulted. For data transfer with personal computers, **`'IBM'`** must be chosen.

```
>RS232 settings
RS control:           ON
```

ON,OFF

Control via RS232 interface

`ON`	Data receipt via RS232 interface switched on.
`OFF`	Data receipt via RS232 interface switched off (no external control via RS232 possible).

4.2.2 Locking keyboard functions

Switch on +

Certain domains of the user dialog can be made inaccessible to the novice user by locking particular keys. For example, the inadvertent overwriting of a method or even the changing of parameters can be prevented in this way.

The menu '**>keyboard options**' for the corresponding functions is opened by holding down the <CONFIG> key while switching on the 788 IC Filtration Sample Processor. Alternatively, a reset can be executed by pressing <CLEAR> and then the <CONFIG> key within 0.4 seconds. This menu is also accessible when the entire keyboard has been locked

The individual key domains that can be locked are the following:

```
>keyboard options
lock keyboard:      OFF
```

ON,OFF

Locking the entire keyboard

If, during routine use, only one particular method is to be used, it may be desirable to block manual manipulations on the 788 IC Filtration Sample Processor. Almost all the keys on the keyboard can be locked for this purpose. The <START>, <STOP> and <CLEAR/RESET> keys however, remain operable so that it is still possible to start and stop a method. This can also be beneficial when using the 788 IC Filtration Sample Processor with a PC software (e.g. «IC Net»). For this application the keyboard may be disconnected.

```
>keyboard options
lock configuration:  OFF
```

ON,OFF

Locking <CONFIG> key

The basic configuration of the changer can be protected from overwriting. All settings of the configuration menu are no longer accessible at this point.

```
>keyboard options
lock parameters:     OFF
```

ON,OFF

Locking <PARAM> key

If user methods are generally used, it might be wise to protect the stored method parameters from alteration. The parameter menu can then be made inaccessible.

```
>keyboard options
>user methods
```

Submenu for locking method storage functions

```
>user methods
lock method recall:  OFF
```

ON,OFF

Lock loading of methods

```
>user methods
lock method store:   OFF
```

ON,OFF

Lock storage of methods

```
>user methods
lock method delete:  OFF
```

ON,OFF

Lock deletion of methods

```
>keyboard options
lock display:        OFF
```

ON,OFF

Locking the display

If the 788 IC Filtration Sample Processor is to be operated exclusively by an external control software (e.g. «IC Net»), the display for manual operation can be switched off.

4.3 Methods

4.3.1 Structure of a method

A **method** consists of the following parts:

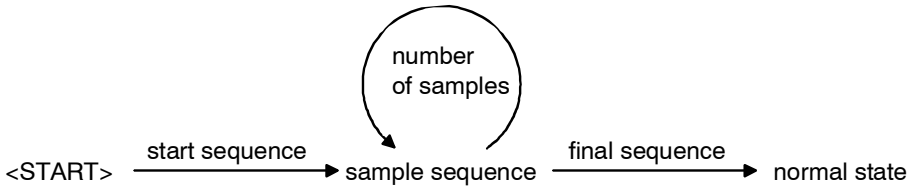
- Number of samples to be processed
- Process sequences (start, sample and final sequence)
- Definition of the various instrument settings (changer settings, manual stop options)

These method parameters are accessible by pressing the <PARAM> key (see *section 4.3.2*). With the <USER METHOD> key, methods can be stored, loaded and deleted (see *section 4.3.8*).

A **sequence** is a succession of commands that are carried out in the order specified during automatic processing of a sample series. There are functions for controlling lift and pump and for moving the turntable (racks). External instruments (732 IC Detector, 709 IC Pump, 752 Pump Unit, etc.) can be controlled using the corresponding commands.

Processing a sample series is accomplished in three phases. These are:

- **Start sequence** Sequence of commands that is executed once at the beginning of a series.
- **Sample sequence** Sequence of commands used for each sample.
- **Final sequence** Sequence of commands that is executed once at the end of a series.



The creation of sequences is done in the submenus **'>start sequence'**, **'>sample sequence'** and **'>final sequence'**, which are accessible via the parameter menu (see *section 4.3.2*).

A sequence is organized in lines. When a command is entered, a new line with the corresponding command is added after the command that is displayed at the moment. The line number is visible in the display. 99 lines per sequence are possible.

In a command sequence, the commands that are on the numerical keypad as alternate functions can be used. For the most part these are the same commands that are used for manual operation (see *section 4.4*). However, in a sequence these can exhibit different or more extensive selection possibilities.

4.3.2 Method parameters – <PARAM> key

The <PARAM> key combines the most important parameter settings for the 788 IC Filtration Sample Processor. All these settings constitute a method and may be saved as such (see *section 4.3.8*). The key opens the following main menu:

`parameters` `number of samples: rack`	**Number of samples to be processed (parameter)**
`parameters` `>start sequence`	**Start sequence before sample series**
`parameters` `>sample sequence`	**Sample sequence for sample series**
`parameters` `>final sequence`	**Final sequence after sample series**
`parameters` `>changer settings`	**Sample changer settings**
`parameters` `>manual stop`	**Options with manual stop**

Repeated pressing of the <PARAM> key selects the submenus in turn. Use <↓> or <↑> to move up or down one menu item; use <HOME> or <END> to move to the first or last menu item respectively. The submenu is opened with <ENTER>, <QUIT> returns to the normal state. The following listings show all dialog items which appear under <PARAM>. The values shown in the display are the default values, the possible entry values or ranges are shown below the display.

```
parameters
number of samples:  rack
```

1...999,rack,*

Number of samples to be processed

`rack` = all sample positions of the rack

`*` = infinite number of samples

All sample positions of an engaged rack will be processed when the instrument is on the **`'rack'`** setting (max. number of rack positions – number of special beakers defined). It is important that the 788 IC Filtration Sample Processor can recognize the rack. This is only possible when the rack is at the ground position. It is recommended to initialize the 788 IC Filtration Sample Processor with the <CLEAR> key or <ENDSEQ> and <ENTER> after every rack change.

```
parameters
>start sequence
```

Start sequence of a sample series

The processing sequence entered here is **executed once at the start** of a sample series. This can be useful for switching on external devices, for example.

In this submenu up to 99 command lines can be entered as a processing sequence (see *section 4.3.3*).

```
parameters
>sample sequence
```

Processing sequence for each sample

This processing sequence is **executed during the processing of every sample** of a series.

In this submenu up to 99 command lines can be entered as a processing sequence (see *section 4.3.3*).

```
parameters
>final sequence
```

Final sequence of a sample series

This processing sequence is **executed once at the end** of a sample series. This could be the useful for switching off external devices, for example.

In this submenu up to 99 command lines can be entered as a processing sequence (see *section 4.3.3*).

```
parameters
>changer settings
```

Settings for 788 IC Filtration Sample Processor

```
>changer settings
rack number          2
```

0...16

Rack that is assigned to the method

0 = no particular rack

This setting can force the use of a certain rack with the method chosen. If this is not desired, the rack number **'0'** must be chosen.

```
>changer settings
lift rate 1      12 mm/s
```

3...12 mm/s

Stroke speed of lift

```
>changer settings
shift rate           20
```

3...20

Rack shift rate

Turning speed of the rack in angular degrees/second

```
parameters
>manual stop
```

Actions at manual stop

The following entries define the commands or signals that are transmitted via the interfaces when the <STOP> key is pressed. This enables peripheral instruments connected to be stopped automatically.

```
>manual stop
CTL Rmt:  **************
```

14 bit (1,0 or *)

Signal output via remote interface

The 3 lines 11, 12 and 13 are occupied for the swing head and are therefore ignored (see *section 5.1*).

```
>manual stop
CTL RS232:
```

14 ASCII characters

Data to be transmitted via RS232 interface

Clear value **'&PR;$S'**

4.3.3 Programming of sequences

The creation of sequences is done in the submenus **'>start sequence'**, **'>sample sequence'** and **'>final sequence'**, which are accessible via the parameter menu (see *section 4.3.2*).

Each sequence is organized in lines. In each line, the commands that are on the numerical keypad as alternate functions can be used to enter commands (see *section 4.3.6*). After selecting a command and entering the necessary data, the entry is accepted with <ENTER>. The line number is visible in the display. 99 lines per sequence are possible.

Navigation in a sequence is accomplished as in the other menus. In addition the <INSERT> and <DELETE> keys can be used.

<INSERT> adds a new command line **above the current line** in a sequence. It is automatically occupied by the "NOP" command that has no function. The following lines are shifted one line downwards.

<DELETE> deletes the current line in a sequence. The following lines are shifted one line upwards.

The "**LEARN**" mode is available for the easy entry of parameters (details see *section 4.3.4*).

Furthermore the "**TRACE**" function can be used to execute every command line step by step (details see *section 4.3.5*).

4.3.4 LEARN mode

When editing a method, the parameters of a command are most easily determined experimentally, i.e. by manual execution, and it is for this reason that certain commands are "teachable". The LEARN function makes the manual execution of particular changer commands possible during the editing of a sequence. The resulting parameters (for example, the lift position or the status of the input lines) can be taken over in the current command line. The LEARN function can be used repetitively. When times or volumes are "learned", the repetitive values are added up.

Procedure for creating a method

- Enter a command or select an existing command line.
- Press the <LEARN> key.
  - Function is started, "LEARN" LED lights up.
  - Press the <LEARN> key.
  - Function is stopped, "LEARN" LED blinks.
  - With the <ENTER> key, accept the value (or re-start the LEARN function).
- "LEARN" LED goes out, edit next command line.

The LEARN function can be used with the following commands:

Command	*Teachable parameter*	*Mode of function*
LIFT	Lift position in mm	absolute
PUMP	Pump time in sec	additive
WAIT	Waiting time in sec	additive
SCN Rm	Status of the 8 remote lines	"live" value
SCN RS	Character sequence received	"live" value

4.3.5 TRACE function

The "TRACE" function is a valuable aid for operating through an entire sequence or method (or parts thereof) for test purposes. Every command line in a sequence can be executed directly by pressing the <START> key. Upon completion of the action the next command line is displayed.

Tracing can be executed immediately after entry of a sequence line or at any time after opening the parameter menu and selecting a sequence.

4.3.6 Commands for sequences

The following commands are programmable within a sequence. Most of them are also available in manual operation but may vary partially in their operation or exhibit a limited parameter selection (see *section 4.4*).

SAMPLE


```
>start sequence
 1 SAMPLE:     =       1
```

=,+,–; 1…999

Define current sample position

The SAMPLE command defines the rack position for the current sample (**`SAMPLE = X`**). This is stored as a index variable. It may be modified for example, in a sample sequence (**`SAMPLE + X`** or **`SAMPLE – X`**), in order to control the course of a sample series during processing.

The SAMPLE command does not have to be used for simple applications. As a general rule the first sample of a series is assumed to be in rack position 1 unless specified otherwise. Therefore it is recommended not to place the special beakers in the first rack positions; place them in the highest positions instead.

Before starting a sample series, the position of the first sample can be defined with the <SAMPLE> key in manual operation, as long as this has not been defined in the method itself.

If a certain sample tube order is needed for each application of a method, the position of the first sample can be defined in the start sequence with **`'SAMPLE = X'`** and this setting can be saved with the corresponding method.

If the SAMPLE command is not executed during a sample sequence, the SAMPLE variable will be increased by 1 after every processing of the sample sequence.

MOVE


```
>sample sequence
 2 MOVE  1     :  sample
```

sample,spec.1…8,1…999

Position vessel / Turn rack

The MOVE command can place the current sample tube or a special beaker below the needle position by rotating the rack. An absolute rack position can also be specified.

During method processing a MOVE command automatically sets the lift to the shift position. In the parameter menu under **`'>changer settings'`** the turning speed can be defined specifically for each method.

If there is no sample tube in the rack position chosen, this is not recognized by the IC Sample Processor, and air is aspirated instead of sample solution. Therefore always make sure that sample tubes are placed at all rack positions defined in the processing sequence.

LIFT


```
>sample sequence
 3 LIFT: 1  :    rest mm
```

work,rinse,shift,
special,rest,0...125 mm

Position the lift

Raising or lowering the lift to a defined position. Work, rinse, shift and special position are rack-specifically defined in the Configuration menu under **'>rack definitions'** (see *section 4.2.1*).

The rest position is the zero position (0 mm) of the lift, i.e. the upper stop.

Each lift can also be precisely positioned to the millimeter. The LEARN function is also available for this purpose (see *section 4.3.4*).

With LIFT commands, please note that if you are using the 6.1835.020 PEEK tubing, the sample tubes may ***not be sealed with caps*** *because they cannot be pierced by the PEEK tubing !*

PUMP


```
>sample sequence
 4 PUMP  1.1   :     1 s
```

1...999 s,ON,OFF

Pump control

With the <PUMP> command the peristaltic pump of the 788 IC Filtration Sample Processor can be controlled.

The pump can be turned off and on as desired or operated for a specific amount of time. The LEARN function is useful for determining the interval of time (see *section 4.3.4*).

SCAN


```
>sample sequence
 5 SCN:Rm      :  Ready1
```

Scanning the remote interface

Rm,RS	Ready1	= Waiting until 732/1 is ready
	End1	= Waiting for EOD pulse of 732/1
	End2	= Waiting for EOD pulse of 732/2
	Wait1	= Waiting until remote line 3 of 732/1 is set to 1
	Wait2	= Waiting until remote line 3 of 732/2 is set to 1
	Wait*	= Waiting until remote line 3 of 732/1 and 732/2 are set to 1
	Pump1 ?	= Waiting until IC Pump 709/1 is running
	Pump2 ?	= Waiting until IC Pump 709/2 is running
	Pump* ?	= Waiting until IC Pumps 709/1 and 709/2 are running
8 bit (1,0 or *)		any 8-bit pattern

In a sequence the **SCN:Rm** command causes method processing to stop until the predefined bit pattern is received.

Predefined bit patterns are supported which can be selected by short names (e.g. **'Ready1'** or **'End2'**).

'Ready' signifies a static "ready" line of an external instrument. **'End'** stands for pulse signals, for example EOD (= end of determination). When scanning for pulse signals parallel scanning of several lines cannot be applied.

Setting special bit patterns allows flexible control of connected instruments.

Here the following is valid:
0 = line inactive
1 = line active
***** = arbitrary line state

Example: **00000001** = input line 0 is active = instrument 1 "ready"

The bit pattern (= line state) can be taken over interactively with the LEARN function (see *section 4.3.4*).

For details about the remote interface, see *section 5.1*.

SCAN 1

```
>sample sequence
 6 SCN:RS
```

Scanning the RS232 interface

Rm,RS
14 ASCII characters arbitrary series of 14 characters

In a sequence the **SCN:RS** command causes method processing to stop until the predefined character string (up to 14 characters) is received via serial RS232 interface. The received data is compared character by character.

Be sure that the interface parameters agree with those of the instrument connected (see Configuration menu **'>RS232 settings**, *section 4.2.1*).

Any letters, numbers and special characters from the character set of the IC Filtration Sample Processor can be chosen. The asterisk **'*'** may be used as a wildcard for an arbitrary character or character string. (If **'*'** is to be interpreted as an ASCII character, **'**'** has to be set). A wildcard may be used in any position of a character string. If the first part of character string is correctly identified, the first appearance of the character following the asterisk **'*'** is scanned. When it is found, the next part of the character string is compared.

This function is especially suited to instruments with Metrohm remote control language. Here the autoinfo status messages can be scanned. For example, the 732 IC Detector has the following possibilities for scanning autoinfo information:

R" Ready, "Ready" state reached, e.g. at program end
S" Stop, instrument manually stopped
W" Instrument in wait status
E" Error, error message

These status messages, however, are only transmitted if the corresponding status message has been previously switched on, for example, in the the start sequence (e.g. for the "Ready" message of the 732 IC Detector 732 with the command **'CTL:RS &Set.A.R"on"'**).

More detailed information about the syntax can be found in the Instructions for Use of the instrument from which the status messages should be transmitted.

With the LEARN function transmitted data (= character strings) can be taken over interactively (see *section 4.3.4*).

CTL

CTRL 2

```
>sample sequence
 7 CTL:Rm:          INIT
```

Setting the remote lines

Rm,RS INIT	= initialize remote lines of 788
INIT 732	= initialize remote lines of 732/1 and 732/2
PROG R/S 1	= run/stop time program at 732/1
PROG R/S 2	= run/stop time program at 732/2
PUMP R/S 1	= run/stop IC Pump 709/1
FILL A 1	= switch valve A at 733/1 to "Fill"
INJECT A 1	= switch valve A at 733/1 to "Inject"
FILL B/STEP 1	= switch valve B at 733/1 to "Fill" or switch suppressor to next position
INJECT B 1	= switch valve B at 733/1 to "Inject"
ZERO 1	= trigger the autozero function at 732/1
PUMP 752 ON	= switch on pump at 752/753
PUMP 752 OFF	= switch off pump at 752/753
STEP MSM 753	= switch suppressor at 753 to next position
******0*001***	= run/stop IC Pump 709/2
******0*010***	= switch valve A at 733/2 to "Fill"
******1*000***	= switch valve A at 733/2 to "Inject"
******0*101***	= switch valve B at 733/2 to "Fill" or switch suppressor to next position
******1*010***	= switch valve B at 733/2 to "Inject"
******0*011***	= trigger the autozero function at 732/2
*******1******	= switch on pump at 754 (with 6.2143.220 cable)
*******0******	= switch off pump at 754 (with 6.2143.220 cable)
14 bit (1,0 or *)	arbitrary 14 bit pattern

The **CTL:Rm** command controls external instruments via the remote interface. It causes the setting of defined line states or the sending of pulses via the 14 remote output lines.

Predefined bit patterns are supported which can be selected by short names (e.g. **'INIT 732'** or **'ZERO 1'**).

Setting particular bit patterns allows flexible control of connected instruments.

Here the following is valid:
0 = line inactive
1 = line active
***** = do not change line state

Example: *****000*******1** = Output line 0 active
= start/stop time program at 732/1

For details about the remote interface, see *section 5.1*.

CTRL 2

```
>sample sequence
 8 CTL:RS
```

Data communication via serial RS232 interface

Rm,RS	
Clear value: &D.S"9"	= start/stop time program at 732
14 ASCII characters	arbitrary string of 14 characters

Data (= character string) can be sent to instruments connected via the serial RS232 interface.

Make sure that the transmission parameters of the RS232 interface correspond to those of the connected instrument (see Configuration menu **'>RS232 settings'**, *section 4.2.1*).

Any letters, numbers and special characters can be chosen from the character set of the 788 IC Filtration Sample Processor.

This function is suitable for instruments with Metrohm remote control language. These can be controlled with so-called triggers.

&M;$G	Go, start instrument in current mode
&M;$S	Stop, stop instrument
&M;$Q	Query, request of information

The following remote control commands (for example, in a start sequence) can switch on the autoinfo status messages of the 732 IC Detector 732:

&Set.A.R"on"	"Ready" status message
&Set.A.S"on"	status message at manual stop
&Set.A.W"on"	status message at waiting state
&Set.A.P"on"	status message at switching on the instrument
&Set.A.E"on"	status message during an error condition

To be consistent, the corresponding autoinfo messages should also be switched off again in a final sequence (**..."off"**).

Detailed information about the syntax of the Metrohm remote control language can be found in *section 5.2* or in the instruction manual of your instrument. Please keep the syntax and conventions of the foreign instruments or computers the 788 IC Filtration Sample Processor is communicating with.

WAIT

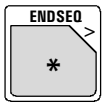

```
>sample sequence
 9 WAIT              1 s
```

Waiting time

0…1…9999 s

The WAIT command sets a particular waiting interval during method processing.

ENDSEQ




```
>sample sequence
10 ENDSEQ
```

End of the sequence

End mark of a sequence. This ENDSEQ command can be inserted in any desired command line for test purposes. This has the effect that the sequence (start, sample, or final sequence) is processed only up to this line.

4.3.7 Process control

With **<START>** a method is started from the normal state. If there is no manual intervention or unexpected errors, the sample series is correctly processed and closed with the final sequence. The sample sequence is executed repeatedly according to the entry under **'number of samples'**, beginning with the sample tube that is defined as **'SAMPLE'**.

If the sample series is interrupted with **<STOP>**, the 788 IC Filtration Sample Processor returns immediately to the normal state. Samples that have not been processed are ignored and the end sequence is not executed. If settings for such instances have been activated under **'manual stop options'**, the corresponding actions or commands are also executed via the interfaces to stop instruments that are connected or to initiate other actions.

With **<HOLD>** the processing of a method can be interrupted. The command that is active at this point is immediately interrupted as a result. <START> continues the active sequence beginning with the command immediately following the one interrupted. Any peripheral instrument connected is **not** stopped with the <HOLD> key.

<CLEAR> interrupts a sample series at the end of a currently active sequence (soft break). The sample currently being processed will be completed.

<QUIT> interrupts the command currently being executed and starts the next command line in the sequence.

If errors occur during the sample series, the corresponding **error message** is displayed and must be acknowledged with **<QUIT>**. The 788 IC Filtration Sample Processor then goes into the HOLD status (see above). After remedying the error, <START> resumes the sequence or <STOP> halts it entirely.

During the course of a method it is possible to change all entries in the menus **'>configuration'** and **'>parameters'**. These changes have an immediate effect on the course of the method (with few exceptions, see *section 4.2.1*).

Care should be taken when editing process sequences. These can be edited "live" (including insertion or deletion of a command line). The TRACE and LEARN functions however, are not available in this case. Testing of the edited function is therefore not possible. Illogical command sequences could easily result, which would cause an error condition and force the interruption of a sample series.

4.3.8 User defined methods

The <USER METHOD> key is used for the management of user defined methods, which can be stored and recalled under freely selectable names. A method comprises the parameters defined under the <PARAM> key. The key opens the following main menu:

`methods` `>recall method`	**Recall method**
`methods` `>store method`	**Store method**
`methods` `>delete method`	**Delete method**

Repeated pressing of the <USER METHOD> key selects the submenus in turn. Use <↓> or <↑> to move up or down one menu item; use <HOME> or <END> to move to the first or last menu item respectively. The submenu is opened with <ENTER>, <QUIT> returns to the normal state. The following listings show all dialog items which appear under <USER METHOD>. The values shown in the display are the default values, the possible entry values or ranges are shown below the display.

`methods`
`>recall method`

Recall existing method

`>recall method`
`method: ********`

8 ASCII characters

Selection of the method

With <SELECT> any method saved can be chosen. If an "empty" method is to be loaded, the method `'********'` can be selected. Like this, the actual work memory is deleted.

`methods`
`>store methods`

Storage of methods

`>store methods`
`method: ********`

8 ASCII characters

Define method name

"<" or ">" activates text edit mode where any method name desired can be entered (see *section 4.1.6*).

When a certain method should be worked off after switching on the 788 IC Filtration Sample Processor, a command sequence can be stored under the name `'POWERUP'`. This method is started automatically after switching on the main switch (see *section 4.3.9*).

```
methods
>delete method
```

Deletion of methods

```
>delete method
method:         ********
```

8 ASCII characters

Selection of the method

Selection of the method which should be deleted using the <SELECT> key.

```
>delete method
delete ******** ?
```

Confirmation of the deletion

Confirmation with <ENTER>

Abort with <QUIT>

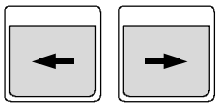
4.3.9 POWERUP method

When the 788 IC Filtration Sample Processor is switched on, the sample rack and the needle are brought into the rest position. To bring them to other positions, the "POWERUP" method can be used. This method is started automatically, when the 788 IC Filtration Sample Processor is switched on.

Create a method that contains the command sequence which should be worked off, when the 788 IC Filtration Sample Processor is switched on. Store this method under the name **'POWERUP'** (see *section 4.3.8*).

4.4 Manual operation

4.4.1 Turning the sample rack / Positioning the samples



Using the <←> and <→> keys the sample rack can be turned one position to the left (in the counterclockwise direction) or right (clockwise).


```
manual operation
MOVE  1        :  sample
```

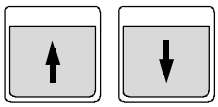
Position vessel / Turn rack

sample,spec.1...8,
1...999

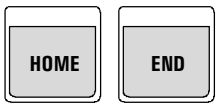
With the MOVE command, a particular sample tube or other vessel can be placed under the needle. With <SELECT> the numerical rack position as well as the predefined current sample (SAMPLE command) or the special beakers 1-8 can be chosen.

For security reasons turning the sample rack is only possible when the lift is in or above the shift position.

4.4.2 Moving the lift



The keys <↑> and <↓> allow upward and downward movement of the lift. The lowest possible lift position is defined by the configuration parameter **'max. lift way'**.



The <HOME> key runs the lift to the rest position (0 mm), i.e. to the upper limit.

<END> runs the lift to the predefined work position (see *section 4.3.2*).


```
manual operation
LIFT: 1     :    rest mm
```

Position the lift

work,rinse,shift,
special,rest,
0...125 mm

With the LIFT command, the lift can be run to a given position. In addition to selecting an exact position in mm (0 - 125 mm), the <SELECT> key can select a predefined position (work position, rinse position, shift position, special position, rest position = 0 mm).

4.4.3 Setting the sample position


```
manual operation
SAMPLE:     =          1
```

1...999

Define current sample position

The <SAMPLE> command serves to set the current sample position. It defines the first sample tube for the subsequent sample series.

4.4.4 Pump control


```
******** counter   1/128
PUMP+             ready
```

PUMP+, PUMP-

Switch pump on/off

The PUMP command is used to switch on/off the peristaltic pump at the 788 IC Filtration Sample Processor. The pump command switches the selected pump on or off, according to the current state. The current state of the pumps is shown directly in the display:

Pump switched on: **PUMP + (+ = ON)**

Pump switched off: **PUMP - (- = OFF)**

By pressing <STOP> the pump is also stopped.

4.4.5 Display interface signals


```
manual operation
SCN:Rm          :00000000
```

Rm,RS
0,1

Display remote interface signals

The **SCN:Rm** command causes the signal states of the incoming remote lines to be displayed in binary form (**1** = line active, **0** = line inactive).

```
manual operation
SCN:RS
```

Rm,RS ASCII characters

Display RS232 interface signals

The **SCN:RS** command causes the character string received at the RS232 interface to be displayed line by line (14 characters).

4.4.6 Interface control


```
manual operation
CTL:Rm   :          INIT
```

Setting the remote lines

Rm,RS INIT	= initialize remote lines of 788
INIT 732	= initialize remote lines of 732/1 and 732/2
PROG R/S 1	= run/stop time program at 732/1
PROG R/S 2	= run/stop time program at 732/2
PUMP R/S 1	= run/stop IC Pump 709/1
FILL A 1	= switch valve A at 733/1 to "Fill"
INJECT A 1	= switch valve A at 733/1 to "Inject"
FILL B/STEP 1	= switch valve B at 733/1 to "Fill" or switch suppressor to next position
INJECT B 1	= switch valve B at 733/1 to "Inject"
ZERO 1	= trigger the autozero function at 732/1
PUMP 752 ON	= switch on pump at 752/753
PUMP 752 OFF	= switch off pump at 752/753
STEP MSM 753	= switch suppressor at 753 to next position
******0*001***	= run/stop IC Pump 709/2
******0*010***	= switch valve A at 733/2 to "Fill"
******1*000***	= switch valve A at 733/2 to "Inject"
******0*101***	= switch valve B at 733/2 to "Fill" or switch suppressor to next position
******1*010***	= switch valve B at 733/2 to "Inject"
******0*011***	= trigger the autozero function at 732/2
*******1******	= switch on pump at 754 (with 6.2143.220 cable)
*******0******	= switch off pump at 754 (with 6.2143.220 cable)
14 bit (1,0 or *)	arbitrary 14 bit pattern

The **CTL:Rm** command controls external instruments via the remote interface. It causes the setting of defined line states or the sending of pulses via the 14 remote output lines. Predefined bit patterns are supported which can be selected by short names (e.g. **'INIT 732'** or **'ZERO 1'**).

Here the following is valid: **0** = line inactive
1 = line active
***** = do not change line state

Example: *****000*******1** = Output line 0 active
= start/stop time program at 732/1

For details about the remote interface, see *section 5.1*.

```
manual operation
CTL:RS
```

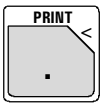
Data communication via RS232 interface

Rm,RS	
Clear value: &D.S"9"	= start/stop time program at 732
14 ASCII characters	arbitrary string of 14 characters

Using the **CTL:RS** command data (= character string) can be sent to instruments connected via the serial RS232 interface.

For details about the remote interface, see *section 4.3.6* and *section 5.2*.

4.4.7 Print out reports




```
******** counter   1/128
Print:              param
```

Print out a report

`all`	All reports in the order **`usermeth`**, **`config`**, **`param`**
`config`	Configuration report
`param`	Method parameter report
`usermeth`	Report of stored methods

The <PRINT> key is used for the output of reports on an external printer or PC connected to the RS232 interface (see *section 2.5*).

Example of "config" report

```
 'co
788 IC Filtr. Proc.           5.788.0010
configuration
>auxiliaries
  dialog:              english
  display contrast           3
  beeper:                   ON
  device label
  program           5.788.0010
  max. lift way           125 mm
>rack definitions
  number  code    type
  1       000110  M128-2
  work position           125 mm
  rinse position          125 mm
  shift position            0 mm
  special position          0 mm
  position special beaker 1...8
  127  128  0   0   0   0   0   0
  number  code    type
  2       010001  M129-2
  work position           125 mm
  rinse position          125 mm
  shift position            0 mm
  special position          0 mm
  position special beaker 1...8
  128  129  0   0   0   0   0   0
  number  code    type
  3       001010  M142-2
  work position           125 mm
  rinse position          125 mm
  shift position            0 mm
  special position          0 mm
  position special beaker 1...8
  142  0   0   0   0   0   0   0
>RS232 settings
  baud rate:             9600
  data bit:                 8
  stop bit:                 1
  parity:                none
  handshake:              HWs
  character set:          IBM
  RS control:              on
          ------------
```

Example of "param" report

```
 'pa
788 IC Filtr. Proc.           5.788.0010
parameters
  method              ********
  number of samples:     rack
>start sequence
>sample sequence
>final sequence
>changer settings
  rack number               0
  lift rate 1              12 mm/s
  shift rate               20
>manual stop
  CTL Rmt:     **************
  CTL RS232:
          ------------
```

Example of "usermeth" report

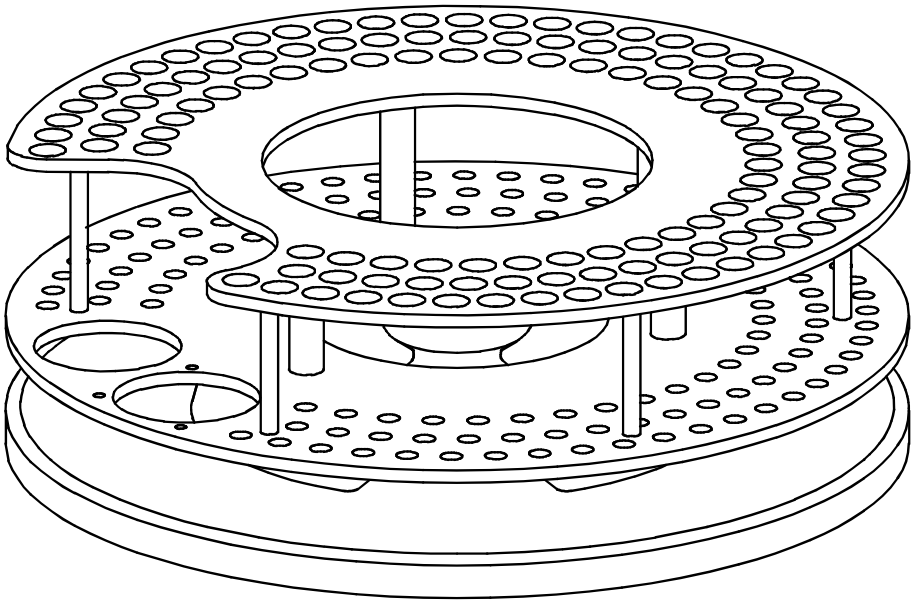
```
 'um
788 IC Filtr. Proc.           5.788.0010
user memory
>methods
  PC                                 760
  PC Seg                             808
  SP                                 872
  SP Seg                             920
  761                                632
  761 Seg                            672
  An Cat                            1328
  AnCatSeg                          1416
  Preconc                           1024
  Dialysis                          1656
         remaining bytes           17808
          ------------
```

4.5 Sample racks

4.5.1 Standard rack (6.2041.430)

Metrohm delivers the following standard sample rack for the 788 IC Filtration Sample Processor:

Type	*Number of vessels*	*Type of vessel*	*Predef. code*	*Predef. rack no.*
M129-2	127 2	PP Sample tube (6.2743.050; 11 mL) PE Bottle (6.1608.080; 300 mL)	010001	2



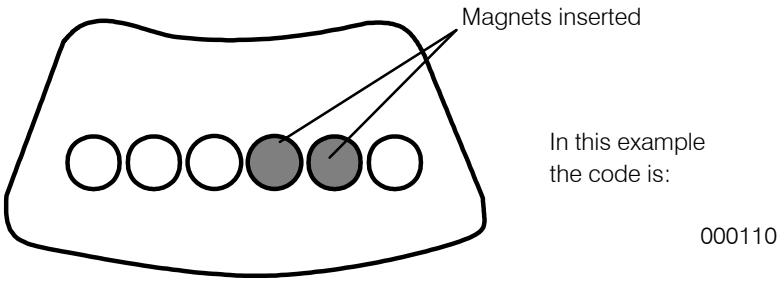
If desired, other user-defined racks can be delivered and defined in the instrument via PC software. Irregular arrangements of vessel positions are also possible.

4.5.2 Magnetic code

Every single rack can be identified by a unique magnetic code. Rod magnets which are attached to the bottom of the rack can be combined to form a 6-place binary code. The 788 IC Filtration Sample Processor can then automatically recognize the mounted rack. This is possible when the rack is positioned in the normal position. When changing a rack, the 788 IC Filtration Sample Processor should first be re-set to the normal position by pressing the <RESET> key or <ENDSEQ> and <ENTER>. This way the save recognition of a rack and therefore the correct vessel positioning is made possible. An internal position table containing the unambiguous definition of the turning angles and vessel positions is assigned to each rack type.

When a sample series is started the 788 IC Filtration Sample Processor first runs the rack automatically into the normal starting position so that it is always ensured that the vessel positions correspond with the internal position table of the current rack.

The rack code is used for automatic rack recognition. A code can be assigned only once. The standard rack supplied by Metrohm already have a predefined code. The rack code is a 6-place binary pattern with the digits 0 and 1 and this has to correspond to the order of the rod magnets. The digit 1 stands for a magnet which is inserted and 0 signifies that no magnet is inserted. 63 different codes are possible (000001 to 111111).



Rack bottom view

In order to assign a certain sample rack for different applications, certain properties or recognition data can be defined for up to 16 racks. This is useful when a certain beaker size or the size of the sample series or a certain course of processing is to be predefined in an application.

4.5.3 Rack data

The following recognition data can be defined for each rack:

Rack number	*unique identification*
Code	*automatic rack recognition*
Type	*rack type / position table*
Work position	*working height of the needle*
Rinse position	*rinsing height of the needle*
Shift position	*turning height of the needle*
Special position	*additional height of the needle*
Special beaker position	*reserved beaker positions*

The **Rack number** serves to identify a rack. It can be chosen from 1 to 16. In a method a particular rack number can be assigned to the process sequences (see *section 4.3.2*). This ensures that if the wrong sample rack is used, the automatic rack recognition will realize this and issue a warning to the user.

The **Code** is used for automatic rack recognition. Make sure that this 6-place binary code in the rack configuration agrees with the actual inserted magnet code on the rack. Rack codes can be changed at any time. They must however, only be assigned to one rack. The assignment of standard predefined codes of standard racks provided by Metrohm should be avoided. There is one code which can be used for this purpose. It is normally used for special racks: 110000.

The rack **Type** serves for the assignment to a position table internal to the instrument, in which the positions of the sample tubes in the rack are defined in tenths of a degree (0-3599) of the full turning angle. The rack type is coded as **Mxxx-y**, whereby **M** stands for Metrohm-defined types. The placeholder **xxx** stands for the number of sample tubes in a rack. The numerical code **y** is a special code for the number of rows on a rack (0 = single-row, 1 = double-row, 2 = triple-row). Position tables for user-defined rack types can be created with a suitable PC software and introduced into the instrument via the serial interface. The name of the rack type may be chosen at will this way.

The **Work position** determines the height of the needle in which the sample solution is aspirated. In this way the ideal position for every sample rack can be chosen dependent on the height of the sample tubes. This work position can be accessed directly in manual operation with the <END> key. In a process sequence this can be programmed with **'LIFT :1 : work mm'**.

The **Rinse position** determines the correct position of the needle in which, for example, a rinsing solution should be aspirated. In this way the ideal position for every sample rack can be chosen dependent on the height of the sample tubes. This rinse position can be accessed with **'LIFT :1: rinse mm'**.

The **Shift position** determines the correct position of the needle, in which the rack can be turned. This height must be 0 mm for the 788 IC Filtration Sample Processor. If the lift is not at or above the shift position, the sample rack can not be turned in manual operation. This is a safety feature to prevent damage to the needle due to turning maneuvers of the rack. However, a prerequisite is that this shift position is correctly set. In a process sequence the positioning of the lift to the shift position can be programmed with **'LIFT :1 : shift mm'**.

The **Special position** determines an additional user defined height of the needle. This special position can be accessed with **'LIFT :1 : special mm'**.

4.5.4 Special beakers

Special beakers are reserved positions in a sample rack. 0 to 8 special beakers can be defined per rack. They can be placed under the needle during method processing for particular operations without interrupting or hindering the sample series run. Special beakers can be used in a sample sequence for rinsing the needle.

Special beakers are placed under the needle with **'MOVE 1 : spec.1'**.

Reserved special beaker positions, that can be individually defined for each rack, are recognized as such in a sample series and are omitted during processing of the individual sample beakers.

For the 6.2041.430 sample rack, the two positions 128 and 129 are already defined as special positions for the 6.1608.080 PE bottles (300 mL).

Sample method for the use of special beakers

With this method **'PCRinse'**, modified from the standard method **'PC'**, the needle and the tubing leading to the sample loop is rinsed with rinsing solution during 60 s after each sample. For this method, a 6.1608.080 PE bottle filled with rinsing solution must be set as special beaker 2 on position 129 of the sample rack.

```
788 IC Filtr. Proc.            5.788.0010
parameters
  method                PCRinse
  number of samples:       rack
>start sequence
   1 CTL:Rm:               INIT
>sample sequence
   1 SCN:Rm      :        Wait1
   2 SCN:Rm      :      Pump1 ?
   3 MOVE  1     :       sample
   4 LIFT: 1  :            work mm
   5 CTL:Rm:           FILL A 1
   6 PUMP  1.1   :          240 s
   7 CTL:Rm:             ZERO 1
   8 CTL:Rm:         INJECT A 1
   9 MOVE  1     :       spec.2
  10 LIFT: 1  :           rinse mm
  11 PUMP  1.1   :           60 s

>final sequence
>changer settings
  rack number                 0
  lift rate 1                12 mm/s
  shift rate                 20
>manual stop
  CTL Rmt:     **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack
- Initialize remote interface

- Wait until 732 IC Det. sends signal on remote line 3
- Wait until 709 IC Pump runs
- Move needle to sample
- Place needle at working position
- Switch injection valve A at 733 to "Fill"
- Fill sample loop with sample during 240 s
- Trigger autozero at 732 IC Detector
- Switch injection valve A at 733 to "Inject"
- Move needle to rinsing solution
- Place needle at rinsing position
- Rinse tubing to injection valve during 60 s with rinsing solution

- —— Settings for changer functions ——

- —— Reaction to manual stop ———

4.6 Standard methods

The following pages contain listings of standard user methods included with the instrument with explanations of the important commands. They are required if the full control of the 788 IC Filtration Sample Processor is not done by the PC directly.

Therefore, the standard methods are required for the combination of the 788 IC Filtration Sample Processor with the following Metrohm IC systems:

- **761 Compact IC** or **790 Personal IC** (see *section. 2.6*). These IC systems work as "Master" and hold the time control of the IC methods.
- Modular Metrohm IC Systems, connected to the PC by the **714 PC Board** or **771 IC Compact Interface**. Using the PC software «**IC Net**» or «**IC Metrodata**», a remote control via an additional serial connection is possible (see section 2.6).

  For this configuration, two different versions exist: Either the 788 IC Filtration Sample Processor controls the time steps of the IC method (788 as "Master") or the 732 IC Detector and the connected PC, respectively, hold this time control (732 as "Master").

The following table briefly describes all standard methods of the 788 IC Filtration Sample Processor. In the following sections, they are explained for their usage in combination with the IC systems mentioned above. The specific IC methods have to be programmed at the 732 IC Detector, via the PC program «IC Net» or via the PC programs for compact IC systems, respectively.

Only with the methods 'SP ' and 'SP Seg' the 788 IC Filtration Sample Processor works as "Master". All other methods are programmed for usage of the 732 IC detector or the compact IC systems 761 and 790 as "Master".

Method Name	*Function*
PC	Processing a queue with the PC program
PC Seg	Like 'PC', additional insertion of an air bubble between the samples
SP	Processing a queue with the PC program with 788 as "Master"
SP Seg	Like 'SP', additional insertion of an air bubble between the samples
761	Processing a queue with 761 Compact IC or 790 Personal IC
761 Seg	Like '761', additional insertion of an air bubble between the samples
An Cat	Simultaneous determination of anions and cations
AnCatSeg	Like 'An Cat', add. insertion of an air bubble between the samples
Preconc	Preconcentration of samples in an preconcentration column
Dialysis	Determination with automatic sample dialysis

All methods with the annex '**Seg**' only differ by one additional step:

```
PUMP   1.1    :              5 s
```

This command is processed before the lift of the 788 IC Filtration Sample Processor is placed to working position. Thereby, a small segment of air is introduced into the tubing between two samples. Therefore, these methods should not be used together with the ultra-filtration cell.

In the following methods, this command is written in brackets without a line number. The corresponding methods with the annex 'Seg' contain this line regularly with its one line number, followed by increased line numbers for the next lines.

It is recommended to work through every new method step-by-step with the TRACE function, making adjustments where necessary, before starting the method for the first time.

The following description of the most standard methods is based on the usage of the PC software «IC Metrodata» for simple remote control of the IC system. Certainly, the program «IC Net 2.X» can be used instead. Additionally, the programming of the 732 IC detector is possible by direct editing at the device.

4.6.1 Method "PC" and "PC Seg"

Application

Processing a queue with the PC program with the PC as "Master".

Interconnection

See *section 2.6.1* (without suppression) and *section 2.6.3* (with suppression)

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.           5.788.0010
parameters
  method                        PC
  number of samples:          rack
>start sequence
   1 CTL:Rm:                  INIT
>sample sequence
   1 SCN:Rm       :          Wait1
   2 SCN:Rm       :        Pump1 ?
   3 MOVE  1      :         sample
   ( PUMP  1.1    :              5 s)
   4 LIFT: 1   :               work mm
   5 CTL:Rm:              FILL A 1
   6 PUMP  1.1    :            240 s
   7 CTL:Rm:               ZERO 1
   8 CTL:Rm:            INJECT A 1
>final sequence
>changer settings
  rack number                    0
  lift rate 1                   12 mm/s
  shift rate                    20
>manual stop
  CTL Rmt:          **************
  CTL RS232:
          ------------
```

– Report header with serial number and program version
– Method name
– Number of samples to be processed (entire sample rack)
– Initialize remote interface
– Waiting until 732 IC Det. sends signal on rem. line 3
– Waiting until 709 IC Pump runs
– Move needle to sample
– Only "PC Seg": aspirate air during 5 s
– Place lift with needle to working position
– Switch injection valve A at 733 to "Fill"
– Fill sample loop with sample during 240 s
– Trigger autozero at 732 IC Detector
– Switch injection valve A at 733 to "Inject"
– —— Settings for changer functions ——
– —— Reaction to manual stop ———

Settings in the «IC Metrodata» program

Definition of IC method (analysis time, start parameters for IC instruments 732, 733 and 709, etc.), additional association of this method with the following time program for the 732 IC Detector:

Method / Equipment / Setup / Program / Text:

0.0	**Puls_788_set**	Set remote line 3 at 732/1 to 1 (s. below)
0.1	**Puls_788_reset**	Set remote line 3 at 732/1 to 0 (s. below)
0.2	**Flag end**	Program end

Method / Equipment / Setup / Program / Remote configuration:

Puls_788_set	**= **1*******	Set remote line 3 at 732/1 to 1
Puls_788_reset	**= **0*******	Set remote line 3 at 732/1 to 0

Method / Equipment:
Start with method

Procedure at program start

1. Start 788 IC Filtration Sample Processor with <START>.
2. Create new queue in the program «IC Metrodata» and start it.

4.6.2 Method "SP" and "SP Seg"

Application

Processing a queue with the PC program «IC Metrodata» with the 788 IC Filtration Sample Processor as "Master".

Interconnection

see *section. 2.6.1* (without suppression) and *section 2.6.2* (with suppression)

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.           5.788.0010
parameters
  method                        SP
  number of samples:          rack
>start sequence
   1 CTL:Rm:                  INIT
   2 CTL:Rm:           PUMP 752 ON
>sample sequence
   1 SCN:Rm       :     Pump1 ?
   2 MOVE  1      :      sample
   ( PUMP  1.1    :           5 s)
   3 LIFT: 1  :               work mm
   4 CTL:Rm:               FILL A 1
   5 PUMP  1.1    :         240 s
   6 CTL:Rm:                ZERO 1
   7 CTL:Rm:             INJECT A 1
   8 WAIT                   1200 s
>final sequence
   1 CTL:Rm:             PUMP R/S 1
   2 CTL:Rm:          PUMP 752 OFF
>changer settings
  rack number                   0
  lift rate 1                  12 mm/s
  shift rate                   20
>manual stop
  CTL Rmt:          **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack)
- Initialize remote interface
- Switch on 752 Pump Unit for suppressor
- Waiting until 709 IC Pump runs
- Move needle to sample
- Only "SP Seg": aspirate air during 5 s
- Place lift with needle to working position
- Switch injection valve A at 733 to "Fill"
- Fill sample loop with sample during 240 s
- Trigger autozero at 732 IC Detector
- Switch injection valve A at 733 to "Inject"
- Waiting time for recording and evaluation of the chromatogram (must be adapted)
- Switch off 709 IC Pump
- Switch off 752 Pump Unit
- —— Settings for changer functions ——
- —— Reaction to manual stop ———

Settings for 732 IC Detector

Setting the measurement parameters.

Settings in the «IC Metrodata» program

Definition of an IC method without method associated remote control. The waiting time **`WAIT`** entered under **`sample sequence`** in the 788 IC Filtration Sample Processor must be equal to the analysis time **Duration**.

Procedure at program start

1. Create new queue in the program «IC Metrodata» and start it.
2. Enter parameter **`number of samples`** for 788 IC Filtration Sample Processor .
3. Start 788 IC Filtration Sample Processor with <START>.

4.6.3 Method "761" and "761 Seg"

Application

Processing a queue of the PC program «761 PC Software» or «790 PC Software» with compact IC systems and the PC as "Master".

Interconnection

See *section 2.5.1.*

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.           5.788.0010
parameters
  method                  761
  number of samples:     rack
>start sequence
   1 CTL:Rm:              INIT
>sample sequence
   1 SCN:Rm      :      Wait1
   2 MOVE  1     :     sample
   ( PUMP  1.1   :          5 s)
   3 LIFT: 1  :           work mm
   4 SCN:Rm      :      Wait1
   5 PUMP  1.1   :        240 s
>final sequence
>changer settings
  rack number               0
  lift rate 1              12 mm/s
  shift rate               20
>manual stop
  CTL Rmt:     **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack)
- Initialize remote interface
- Waiting until compact IC sends signal on rem. line 3
- Move needle to sample
- Only "761 Seg": aspirate air during 5 s
- Place lift with needle to working position
- Waiting until compact IC sends signal on rem. line 3
- Fill sample loop with sample during 240 s
- —— Settings for changer functions ——
- —— Reaction to manual stop ———

Settings in the corresponding PC program

See *section 2.5.1*.

Procedure at program start

1. Start 788 IC Filtration Sample Processor with <START>.
2. Create new queue and method in the PC program «761 Compact IC» or «790 Personal IC», respectively and start it.

4.6.4 Method "An Cat" and "AnCatSeg"

Application

Simultaneous determination of anions and cations.

Interconnection

Siehe section *2.6.4*.

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.          5.788.0010
parameters
  method               An Cat
  number of samples:     rack
>start sequence
   1 CTL:Rm:             INIT
   2 CTL:Rm:      PUMP 752 ON
>sample sequence
   1 SCN:Rm      :      Wait1
   2 SCN:Rm      :    Pump* ?
   3 MOVE  1     :     sample
   ( PUMP  1.1   :          5 s)
   4 LIFT: 1  :           work mm
   5 CTL:Rm:         FILL A 1
   6 CTL:Rm:     STEP MSM 753
   7 PUMP  1.1   :        240 s
   8 CTL:Rm:           ZERO 1
   9 CTL:Rm:       INJECT A 1
  10 SAMPLE:     +          1
  11 MOVE  1     :     sample
   ( PUMP  1.1   :          5 s)
  12 LIFT: 1  :           work mm
  13 CTL:Rm:   ******0*010***
  14 CTL:Rm:         INIT 732
  15 PUMP  1.1   :        240 s
  16 CTL:Rm:   ******0*011***
  17 CTL:Rm:         INIT 732
  18 CTL:Rm:   ******1*000***
  19 CTL:Rm:         INIT 732
  20 SAMPLE:     +          1
>final sequence
   1 WAIT                1200 s
   2 CTL:Rm:     PUMP 752 OFF
>changer settings
  rack number              0
  lift rate 1             12 mm/s
  shift rate              20
>manual stop
  CTL Rmt:     **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack)
- Initialize remote interface
- Switch 752 Pump Unit on for suppression
- Waiting until 732 IC Det. sends signal on rem. line 3
- Waiting until the two 709 IC Pumps run
- Move needle to sample position
- Only "AnCatSeg": aspirate air during 5 s
- Place lift with needle to working position
- Switch injection valve A at 733 to "Fill"
- Switch 753 suppressor module to next position
- Fill sample loop A with sample during 240 s
- Trigger autozero at 732/1 IC Detector
- Switch injection valve A at 733 to "Inject"
- Raise sample position by 1
- Move needle to sample position
- Only "AnCatSeg": aspirate air during 5 s
- Place lift with needle to working position
- Switch injection valve B at 733 to "Fill"
- Initialize remote lines at 732/1 and 732/2
- Fill sample loop B with sample during 240 s
- Trigger autozero at 732/2 IC Detector
- Initialize remote lines at 732/1 and 732/2
- Switch injection valve B at 733 to "Inject"
- Initialize remote lines at 732/1 and 732/2
- Raise sample position by 1
- Wait for final regeneration of suppressor
- Switch 752 Pump Unit off
- —— Settings for changer functions ——
- —— Reaction to manual stop ———

Settings in the «IC Metrodata» program

1. Definition of anion method for channel 1 (analysis time, start parameters for IC instruments 732, 733 and 709, etc.), additional association of this method with the following time program for the 732/1 IC Detector:

Method / **Equipment** / **Setup** / **Program** / **Text:**

0.0	**Puls_788_set**	Set remote line 3 at 732/1 to 1 (s. below)
0.1	**Puls_788_reset**	Set remote line 3 at 732/1 to 0 (s. below)
0.2	**Flag end**	Program end

Method / **Equipment** / **Setup** / **Program** / **Remote configuration:**

Puls_788_set	**= **1*****	Set remote line 3 at 732/1 to 1
Puls_788_reset	**= **0*****	Set remote line 3 at 732/1 to 0

Method / **Equipment:**

Start with method

2. Definition of cation method for channel 2 (analysis time, start parameters for IC instruments 732, 733 and 709, etc.). The analysis time **Duration** must be shorter than the analysis time for the anion method.

Procedure at program start

1. Create queue with cation method for channel 2 in the program «IC Metrodata» and start it.
2. Start 788 IC Filtration Sample Processor with <START>.
3. Create queue with anion method for channel 1 in the program «IC Metrodata» and start it.

4.6.5 Method "Preconc"

Application

Preconcentration of samples with very low concentrations in an preconcentration column (trace analysis). This method is not planned for usage together with the ultra-filtration cell. However, if ultra-filtration is done, the preconcentration time in line 8 has to be increased to maintain a sufficient filtering time, but without complete consuming of the sample solution.

Interconnection

Siehe *section. 2.6.3*.

Installation of the preconcentration column

The preconcentration column, either consisting of the 6.1006.200 Metrosep Anion preconcentration cartridge and the 6.2828.010 glass cartridge holder or the 6.1006.300 preconcentration column, is installed at the injection valve of the 733 IC Separation Center instead of the sample loop (see *Fig. 25*). It is important to install the sample inlet from the 788 IC Filtration Sample Processor at connection 2 of the injection valve in order to run the preconcentration column for the enrichment and the sample injection in the opposite direction.

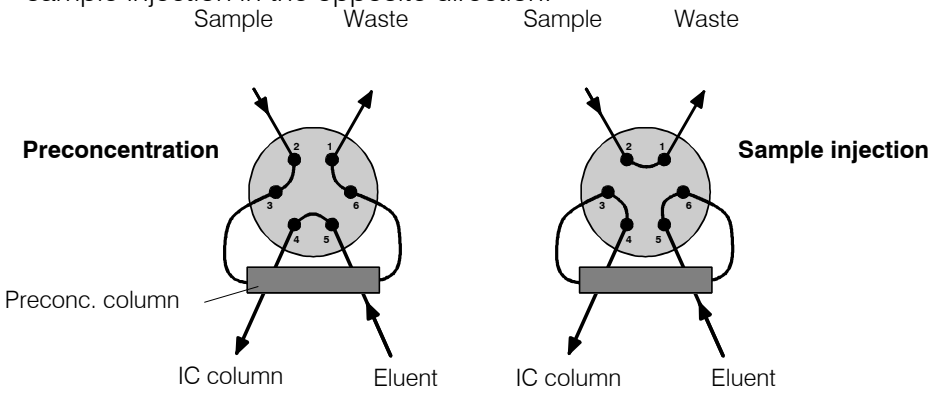


Fig. 25: Installation of the preconcentration column

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.           5.788.0010
parameters
  method              Preconc
  number of samples:     rack
>start sequence
   1 CTL:Rm:              INIT
   2 CTL:Rm:        INJECT A 1
   3 CTL:Rm:       PUMP 752 ON
>sample sequence
   1 SCN:Rm      :       Wait1
   2 SCN:Rm      :     Pump1 ?
   3 MOVE  1     :      sample
   4 LIFT: 1  :           work mm
   5 PUMP  1.1   :          ON s
   6 WAIT                   60 s
   7 CTL:Rm:          FILL A 1
   8 WAIT                  120 s

   9 PUMP  1.1   :         OFF s
  10 CTL:Rm:            ZERO 1
  11 CTL:Rm:        INJECT A 1
>final sequence
   1 WAIT                 1200 s
   2 CTL:Rm:      PUMP 752 OFF
>changer settings
  rack number               0
  lift rate 1              12 mm/s
  shift rate               20
>manual stop
  CTL Rmt:      **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack)
- Initialize remote interface
- Switch injection valve A at 733 to "Inject"
- Switch 752 Pump Unit on for suppression
- Waiting until 732 IC Det. sends signal on rem. line 3
- Waiting until 709 IC Pump runs
- Move needle to sample position
- Place lift with needle to working position
- Switch on pump at 788
- Waiting time 60 s
- Switch injection valve A at 733 to "Fill"
- Sample preconcentration during 120 s (preconcentration time must be adapted)
- Switch off pump at 788
- Trigger autozero at 732 IC Detector
- Switch injection valve A at 733 to "Inject"
- Wait for final regeneration of suppressor
- Switch 752 Pump Unit off
- —— Settings for changer functions ——
- —— Reaction to manual stop ———

Settings in the «IC Metrodata» program

Definition of IC method (analysis time, start parameters for IC instruments 732, 733 and 709, etc.), additional association of this method with the following time program for the 732 IC Detector:

Method / Equipment / Setup / Program / Text:

0.0	**Puls_788_set**	Set remote line 3 at 732/1 to 1 (s. below)
0.1	**Puls_788_reset**	Set remote line 3 at 732/1 to 0 (s. below)
0.2	**Flag end**	Program end

Method / Equipment / Setup / Program / Remote configuration:

Puls_788_set	**= **1*******	Set remote line 3 at 732/1 to 1
Puls_788_reset	**= **0*******	Set remote line 3 at 732/1 to 0

Method / Equipment:
Start with method

Procedure at program start

1. Start 788 IC Filtration Sample Processor with <START>.
2. Create new queue in the program «IC Metrodata» and start it.

4.6.6 Method "Dialysis"

Application

IC determinations with automatic sample dialysis. This method is not planned for usage together with the ultra-filtration cell, which should be bridged. The present method contains a simultaneous separation of one sample and the dialysis of the following sample within the sample sequence. The start sequence just starts the dialysis of the first sample while the final sequence only starts the determination of the final sample.

Interconnection

See *section 2.6.5* as well as *754 Instructions for Use*

Program of 788 IC Filtration Sample Processor

```
788 IC Filtr. Proc.          5.788.0010
parameters
  method             Dialysis
  number of sample:      rack
>start sequence
   1 CTL:Rm:             INIT
   2 CTL:Rm:      PUMP 752 ON
   3 MOVE  1     :          1
   4 LIFT: 1  :        work mm
   5 CTL:Rm:      PUMP 754 ON
   6 WAIT                120 s
   7 CTL:Rm:    FILL B/STEP 1
   8 WAIT                600 s
>sample sequence
   1 SCN:Rm      :    Pump1 ?
   2 CTL:Rm:           ZERO 1
   3 CTL:Rm:     STEP MSM 753
   4 CTL:Rm:         FILL A 1
   5 CTL:Rm:       INJECT B 1
   6 WAIT                 30 s
   7 CTL:Rm:       INJECT A 1
   8 CTL:Rm:     PUMP 754 OFF
   9 SCN:Rm      :      Wait1
  10 SAMPLE:     +          1
  11 MOVE  1     :     sample
  12 LIFT: 1  :          work mm
  13 CTL:Rm:      PUMP 754 ON
  14 WAIT                120 s
  15 CTL:Rm:    FILL B/STEP 1
  16 WAIT                600 s
>final sequence
   1 CTL:Rm:           ZERO 1
   2 CTL:Rm:     STEP MSM 753
   3 CTL:Rm:         FILL A 1
   4 CTL:Rm:       INJECT B 1
   5 WAIT                 30 s
   6 CTL:Rm:       INJECT A 1
   7 CTL:Rm:     PUMP 754 OFF
   8 WAIT               1200 s
   9 CTL:Rm:     PUMP 752 OFF
>changer settings
  rack number             0
  lift rate 1            12 mm/s
  shift rate             20
>manual stop
  CTL Rmt:     **************
  CTL RS232:
          ------------
```

- Report header with serial number and program version
- Method name
- Number of samples to be processed (entire sample rack)
- Initialize remote interface
- Switch 752 Pump Unit on
- Move needle to sample position
- Place lift with needle to working position
- Switch 754 Pump Unit on
- Rinse dialysis cell
- Stop pumping acceptor solution
- Dialysis time
- Waiting until 709 IC Pump runs
- Trigger autozero at 732 IC Detector
- Switch 753 suppressor module to next position
- Switch injection valve A at 733 to "Fill"
- Transfer of acceptor solution to sample loop
- Wait 30 s
- Switch injection valve A at 733 to "Inject"
- Switch 754 Pump Unit off
- Waiting until 732 IC Det. sends signal on rem. line 3
- Raise sample position by 1
- Move needle to sample position
- Place lift with needle to working position
- Switch 754 Pump Unit on
- Rinse dialysis cell
- Stop pumping acceptor solution
- Dialysis time
- Trigger autozero at 732 IC Detector
- Switch 753 suppressor module to next position
- Switch injection valve A at 733 to "Fill"
- Transfer of acceptor solution to sample loop
- Wait 30 s
- Switch injection valve A at 733 to "Inject"
- Switch 754 Pump Unit off
- Wait for final suppressor regeneration
- Switch 752 Pump Unit off
- —— Settings for changer functions ——
- —— Reaction to manual stop ———

Settings in the «IC Metrodata» program

Definition of IC method (analysis time, start parameters for IC instruments 732, 733 and 709, etc.), additional association of this method with the following time program for the 732 IC Detector:

Method / Equipment / Setup / Program / Text:

10.0	**Puls_788_set**	Set remote line 3 at 732/1 to 1 (s. below)
10.1	**Puls_788_reset**	Set remote line 3 at 732/1 to 0 (s. below)
10.2	**Flag end**	Program end

Method / Equipment / Setup / Program / Remote configuration:

Puls_788_set	**= **1*****	Set remote line 3 at 732/1 to 1
Puls_788_reset	**= **0*****	Set remote line 3 at 732/1 to 0

Method / Equipment:

Start with inject

The time of 10 min. given above is the starting time for the dialysis of the next sample. It results from the total chromatogram time (e.g. 20 min.) minus 10 min. Therefore, these time values have to be adapted to varying chromatogram times.

Procedure at program start

1. Create new queue in the program «IC Metrodata» and start it.
2. Start 788 IC Filtration Sample Processor with <START>.

4.7 Filtration

4.7.1 Selecting suitable sample types

Due to the small pore size of the filtration membrane, each filtration step may contribute to possible clogging of the membrane.

In the following table some sample types are described, which have been processed by the 788 IC Filtration Sample Processor. Filtration was performed using the 6.2714.020 filtration membrane (0.15 µm) or a second filtration membrane (0.2 µm). On a Metrohm IC System 7 standard anions were analyzed: F^-, Cl^-, NO_2^-, Br^-, NO_3^-, HPO_4^{2-}, SO_4^{2-}.

Sample	*Pore size of filtration membrane*	*Number of samples per membrane*
orange juice with pulp	0.15	40
surface water	0.15	500
drinking water	0.15	1000
ground water	0.15	500
waste water 1	0.15	1000
waste water 2	0.15	130
waste water 3	0.15	40
waste water 4	0.15	80
NaCl solution (1 %)	0.2	5000
Schöninger decomp. sol.	0.2	100
acid soil extraction	0.2	1000
aqueous soil extraction	0.2	200

The number of samples, which can be filtrated on one membrane without losses of analysis accuracy, is based on experience by Metrohm and its customers. They are intended for evaluation of employment of the ultra-filtration cell for automated sample pretreatment. These values have to be determined for each new application individually.

4.7.2 Filtration membrane life

Analyzing standard solutions, a reducing recovery rate can be taken as an indicator for possible clogging of the filtration membrane. These standards are ideally prepared in the corresponding sample matrix. Therefore, for the analysis of a large number of particle loaded samples, standard solutions should be included, e.g. after every fifth or tenth sample.

Nevertheless, a prediction for the number of possible filtration steps on one membrane cannot be made. Also the development of the recovery rate may vary. The recovery rate could either be constant for a large number of samples and drop abruptly or decrease continuously with another type of sample matrix.

Finally, the sample matrix and the specifications of the analysis method determine the time for changing the filtration membrane. From our experience, suspensions cause membrane clogging earlier than bigger particles in the sample matrix. The latter should be rinsed across the membrane surface.

An instruction for changing the filtration membrane is given in section 6.3.4.

4.7.3 Selecting a suitable filtration membrane

It is possible to transfer existing procedures for sample pretreatment to the ultra-filtration of the 788 IC Filtration Sample Processor. For this purpose different filtration membranes can be used. Please note that undesirable results can be obtained although membrane pore sizes are selected according to known particle sizes of the sample.

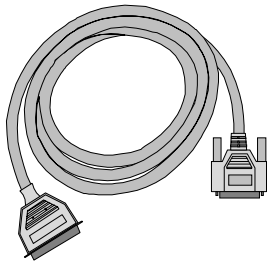
Own investigations have shown that filtration results of common filtration membranes do not always automatically fit to their specified pore sizes. In the following table some qualitative results of own filtration tests are given. Aqueous suspensions with silica particles of known sizes have been filtered on the 788 IC Filtration Sample Processor using membranes with different nominal pore sizes.

test sample: silica particles in water	*pore size of filtration membrane* [1]	*result*
0.5 %, 5 µm	0.15 µm	no breaking-through
0.5 %, 5 µm	3 µm	no breaking-through
0.5 %, 5 µm	8 µm	no breaking-through
0.5 %, 5 µm	10 µm	breaking-through [2]
0.5 %, 5 µm	12 µm	no breaking-through
0.5 %, 1.5 µm	0.15 µm	no breaking-through
0.5 %, 1.5 µm	3 µm	breaking-through

(1) Nominal pore size specified by manufacturer.

(2) Except this one, all other filtration membranes are produced by a single manufacturer.

Due to their low thickness, filtration membranes may provide lower filtration efficiency compared to filters with the same nominal pore size but higher thickness. This should be taken into account for selection of a suitable membrane for online sample pretreatment using the 788 IC Filtration Sample Processor.



5 Interfaces

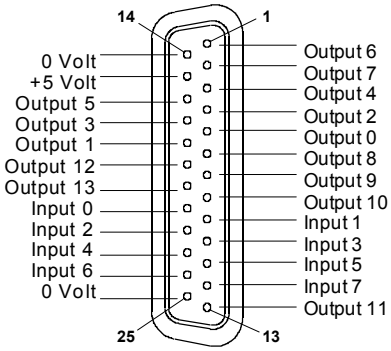
5.1 Remote interface

Peripheral instruments connected such as 732 IC Detector, 709 IC Pump, 752 Pump Unit, etc. can be controlled via the remote interface (25-pin socket).

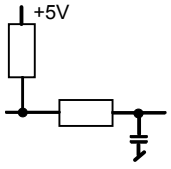
14 lines (Output 0 – 13) are available for the emission signals. Lines 11 – 13 are used for swing head control.

For receiving signals (e.g. the "ready" signal of the 732 IC Detector) 8 lines (Input 0 – 7) are provided. Line 7 is used for the swing head.

5.1.1 Pin assignment of the remote socket



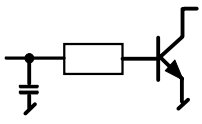
Inputs  t_p >20 ms



active = low
inactive = high

Outputs 

t_p >200 ms
V_{CEO} = 40 V
I_C = 20 mA



active = low
inactive = high

+5V I ≤ 20 mA

The +5 V supply line may by charged with 20 mA maximally.

For the 788 IC Filtration Sample Processor, the output lines 11–13 and the input line 7 are occupied for the control of the swing head. These four lines are not continued in the plug and ignored, when further instruments are connected via the remote cable (see *section 2.4.2*).

Various remote cables are available to use the specific functions of the individual instruments of the various Metrohm model lines (see *section 2.4.2*). Metrohm also delivers special cables on request suited to the customer's needs, which allow complex couplings (including foreign instruments).

5.1.2 Functional characteristics

Output lines

The 14 output lines of the remote socket can be separately set (statically) in manual operation as well as during method processing with the **"Control" command (CTL)**. A 14-place bit pattern must be defined for this. Every bit is assigned to an output line.

Output	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit	13	12	11	10	9	8	7	6	5	4	3	2	1	0

(Bits are always numbered from right to left)

Example: `CTL Rm ***********1*`

sets the output line 1 to active (=set), that for example, would switch on the pump of a connected 752 Pump Unit.

0	=	inactive (high)
1	=	active (low)
*****	=	no change

It is recommended to mask the output lines that are not relevant with a asterisk (*) to prevent alterations to these line states.

Input lines

The 8 input lines of the remote socket are queried during method processing with the **"Scan" command (SCN)**. Method processing is interrupted until the predefined bit pattern compares to the effective state of the input lines (for example, the status of the ready line of the 732 IC Detector). An 8-place bit pattern must be set for this. Every bit is assigned to an input line. If there is correspondence, method processing will continue with the next command line. During manual operation the SCAN command serves as a status display of all input lines.

Input 7 6 5 4 3 2 1 0

Bit **7 6 5 4 3 2 1 0**

(Bits are always numbered from right to left)

Example: `SCN Rm *******1`

expects an active input line 0 (1=set or active). This line is set for example, by the 732 IC Detector, if no program runs.

0	=	inactive (high)
1	=	active (low)
*****	=	arbitrary

Input lines that are not being used or for which no defined state can be predicted, should also be masked here with an asterisk (*).

Control of instruments

With a suitable multi-cable (with special wiring) or with the 6.2125.120 adaptor several instruments can be controlled simultaneously via the remote lines (see *section 2.4.2*). The bit patterns for the CTL and SCN commands can be combined for this. Be aware, however, that some instruments only transmit short impulses (typically 20 ms) at the end of a determination and therefore a combined query of the end of determination with other instruments is only possible under certain conditions (dependent upon time).

To simplify the use of these remote control commands especially when connecting several instruments with Metrohm cables, the following command parameters are available for the CTL and SCN commands. Beside these command parameters the first table contains some further useful, but not implemented bit patterns for the control of IC instruments, which are sent as static signals and not as pulses as for the predefined commands. In order to get such commands becoming effective, the command `'INIT 732'` to reset the remote lines at 732/1 and 732/2 must be sent after each command.

CTL commands

Parameter	*Bit pattern*	*Function*	*Signal*
INIT	**00000000000000**	initializes the remote interface	static
INIT 732	*****0000*000**0**	initializes the remote lines at 732/1 and 732/2	static
PROG R/S 1	*****000*******1**	starts/stops time program at 732/1	pulse (200 ms)
PROG R/S 2	********0*100*****	starts/stops time program at 732/2	pulse (200 ms)
PUMP R/S 1	*****001*******0**	starts/stops 709/1 IC Pump	pulse (200 ms)
FILL A 1	*****010*******0**	switches valve A at 733/1 to "Fill"	pulse (200 ms)
INJECT A 1	*****100*******0**	switches valve A at 733/1 to "Inject"	pulse (200 ms)
FILL B/STEP 1	*****001*******1**	switches valve B at 733/1 to "Fill"	pulse (200 ms)
INJECT B 1	*****110*******0**	switches valve B at 733/1 to "Inject"	pulse (200 ms)
ZERO 1	*****011*******0**	triggers autozero at 732/1	pulse (200 ms)
PUMP 752 ON	*************1***	switches on pump at 752/753	static
PUMP 752 OFF	*************0***	switches off pump at 752/753	static
STEP MSM 753	************1****	switches 753 suppressor module to next position	pulse (200 ms)
[PUMP R/S 2]	********0*001*****	starts/stops 709/2 IC Pump	static
[FILL A 2]	********0*010*****	switches valve A at 733/2 to "Fill"	static
[INJECT A 2]	********1*000*****	switches valve A at 733/2 to "Inject"	static
[FILL B/STEP 2]	********0*101*****	switches valve B at 733/2 to "Fill"	static
[INJECT B 2]	********1*010*****	switches valve B at 733/2 to "Inject"	static
[ZERO 2]	********0*011*****	triggers autozero at 732/2	static
[PUMP 754 ON]	*********1********	switches on pump at 754 (with 6.2143.220 cable)	static
[PUMP 754 OFF]	*********0********	switches off pump at 754 (with 6.2143.220 cable)	static

SCAN commands

Parameter	*Bit pattern*	*Function*
Ready1	*********1**	waits until the "ready" state of 732/1 is reached
End1	******1*****	waits until the 732/1 sends the EOD signal
End2	***1*******	waits until the 732/2 sends the EOD signal
Wait1	*******1****	waits until the 732/1 sets the remote line 3 to 1
Wait2	*****1******	waits until the 732/2 sets the remote line 3 to 1
Wait*	*****1*1****	waits until the 732/1 and 732/2 set their remote line 3 to 1
Pump1 ?	********1***	waits until the 709/1 IC Pump is running
Pump2 ?	***\1*******	waits until the 709/2 IC Pump is running
Pump* ?	***\1***1***	waits until the 709/1 and 709/2 IC Pumps are running

5.2 RS232 interface

5.2.1 General rules for remote control

The 788 IC Filtration Sample Processor is equipped with the comprehensive Metrohm remote control language, which allows full control over the instrument via an RS232 interface, i.e. the 788 IC Filtration Sample Processor can receive data from an external device or send data to an external device. The 788 IC Filtration Sample Processor sends $2\times C_R$ and L_F as the terminator of a requested **data block**. In contrast, C_R and L_F are used as the terminator of a **data line**. On receipt of data from an external device, this must always close its commands with C_R and L_F. If more than one command is sent on a line, '**;**' must be used as a delimiter between the individual commands.

The data are grouped logically and readily understandable. For example, to select the dialog language the command

```
&Config.Aux.Language"english"
```

must be sent with entry of the boldface characters sufficing, in other words

```
&C.A.L"english"
```

All quantities of the 788 IC Filtration Sample Processor are collected in **groups**. The entries for the configuration, for example, are located in the group

```
&Config
```

The 'Config' group contains sub-groups, e.g. for setting the RS232 interface parameters

```
&Config.RSset
```

or for various settings

```
&Config.Aux
```

The data have a hierarchical structure (tree structure). The quantities which appear in this tree are called **objects** in what follows. The dialog language is that object which is called up with the command

```
&Config.Aux.Language
```

Once you are at the desired location in the tree, you can request the value of the object:

```
&Config.Aux.Language $Q      Q for query
```

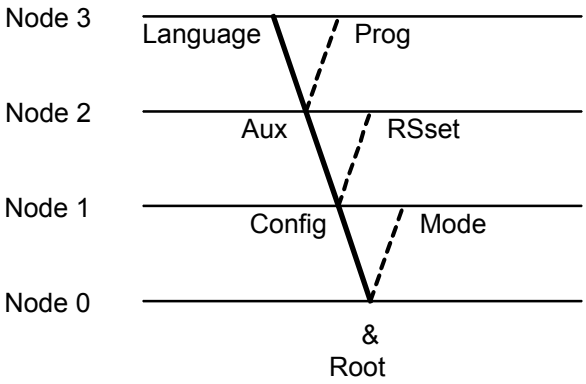
The inquiry '$Q' initiates the output of the value on the instrument, in other words the value output is triggered. Entries which begin with the character '$' always trigger something and are hence referred to as **triggers** in what follows.

However, values of objects can not only be requested, they can also be modified. Values are always inputted in inverted commas, e.g.

```
&Config.Aux.Language"english"
```

5.2.2 Call-up of objects

A section from the object tree is shown below:



The following **rules** apply to the call-up of objects:

Rules	*Examples*
The root of the tree is designated by '**&**'.	
For the call-up of an object, the nodes (levels) of the tree are marked by a point (**.**).	
For the call-up of the objects, as many characters as necessary to allow unambiguous allocation of the object suffice. If the call-up is not unambiguous, the first object in the series is identified.	Call up of the dialog language: **&Config.Aux.Language** or **&C.A.L**
Uppercase and lowercase letters can be used.	**&C.A.L** or **&c.a.l**
A value can be assigned to an object. Values are marked at both their beginning and end by inverted commas ("). They can contain maximum 24 ASCII characters. In the case of parameters with specified text expressions (e.g. on, off), only the English expressions may be used. Numeric values can contain up to 6 digits, a negative sign and a decimal point. Numbers with more than 6 digits are not accepted; more than 4 decimal places are rounded off. With numbers <1, leading zeros must be entered.	Entry of the dialog language: **&C.A.L"english"** Correct numeric entries: "0.1" Incorrect numeric entries: "1,5" or "+3" or ".1"
Until a new object is called up, the old object remains in force.	Entry of a different dialog language: **"deutsch"**
New objects can be addressed relative to the old object: **A leading point** leads one node **forwards** in the tree. **More than one leading point** leads one node **backwards** in the tree. n nodes backwards require n+1 leading points.	From the root to the node 'Aux': **&C.A** Forwards from the node 'Aux' to 'Prog': **.P** Jump from node 'Prog' to the node 'Aux' and selection of the new object 'Language' at this node: **..L**
To return to the root, enter a leading '&'.	Switch from node 'Language' via the root to node 'Mode': **&M**

5.2.3 Trigger

Triggers initiate an action at the 788 IC Filtration Sample Processor , e.g. sequence start or data transmission. Triggers are marked by the introducer '$'.

The following triggers are possible:

$G	Go	Starts processes, e.g. starting the mode run or setting the RS232 interface parameters
$S	Stop	Stops processes
$Q	Query	Used to request all information from the current node in the tree forwards up to and including the values
$Q.P	Path	Used to request the path from the root of the tree up to the current node
$Q.H	Highest Index	Used to request the number of daughter nodes of the current node
$Q.N"i"	Name	Used to request the name of the daughter node with index i, i = 1...n
$D	Detail-Info	Used to request detailed status information
$U	qUit	Used to terminate the data flow of the instrument, e.g. after $Q

The triggers '$G' and '$S' are linked to particular objects, see Overview table in *section 5.2.6*.

All other triggers can always be used at all locations in the data tree.

Examples:

Request of the baud rate value: **&Config.RSset.Baud $Q**

Request of all values of the node 'RSset': **&Config.RSset $Q**

Request of the path of the node 'RSset': **&Config.RSset $Q.P**

Start mode: **&Mode $G**

Request of the detailed status: **$D**

5.2.4 Status messages

To ensure appropriate control of an external control unit is possible, it must also be possible to request status conditions which provide information on the status of the 788 IC Filtration Sample Processor. The output of a status message is triggered by the trigger `'$D'`. Status messages consist of the global status, the detailed status and eventual error messages. The global status informs on the activity of the process, while the detailed status conditions show the exact activity within the process.

The following **global status conditions** are possible:

`$G`	Go	The IC Filtration Sample Processor is executing the last command.
`$H`	Hold	The IC Filtration Sample Processor has been held ($H, <HOLD> key, or by an error which effects the hold status).
`$C`	Continue	The IC Filtration Sample Processor has been re-started actively after hold.
`$S`	Stop	A process has been aborted, e.g. by pressing the <STOP> key or because there was an error.
`$R`	Ready	The IC Filtration Sample Processor has executed the last command and is ready.

Detailed status conditions

Status conditions of the global $R:

`$R.Mode`	Basic state: ready to start automatic processing
`$R.Assembly`	An assembly step has been executed.

Status conditions of the global $G:

`$G.Mode.Start.`	Instrument at the beginning of processing
`$G.Mode.Start.01.WAIT`	Instrument processing the start sequence, displays line number and current command
`$G.Mode.Sample.01.WAIT`	Instrument processing the sample sequence, displays line number and current command
`$G.Mode.Final.01.WAIT`	Instrument processing the final sequence, displays line number and current command
`$G.Mode.`	Instrument processing a manual command
`$G.Assembly.`	Instrument processing an assembly command

Status conditions of the global $H:

`$H.Mode`	The status conditions of the global $H are identical with the ones of the global $G.

5.2.5 Error messages

Error messages 'EXXX' are appended to the status message and separated from this by a ';'.

Error	*Meaning*	*Exit/Corrective action*
E1	Incorrect program checksum	Inform Metrohm service.
E2	RAM read/write error	Inform Metrohm service.
E3	RAM lost data	<QUIT>. If instrument adjustment is necessary, inform Metrohm service.
E4	Timer interrupt for multi-tasking missing	Inform Metrohm service.
E5	RS232 module test error	Inform Metrohm service.
E6	RS232 read/write error	Inform Metrohm service.
E7	Display read/write error	Inform Metrohm service.
E18	Low battery	Inform Metrohm service.
E19	RAM test error	Inform Metrohm service.
E28	Wrong object call-up.	Correct path.
E29	Wrong value.	Enter correct value or new path.
E30	Wrong trigger.	Enter correct trigger or new path.
E36	RS232 receive error; parity.	<QUIT>, set same parity for both devices.
E37	RS232 receive error; stop bit.	<QUIT>, set same stop bit for both devices.
E38	RS232 receive error; overflow (at least 1 character could not be read).	<QUIT>, set same baud rate for both devices, restart sender.
E39	RS232 receive error; overflow of internal receive buffer (>82 characters).	<QUIT>.
E40	RS232 send error; DSR=OFF. Handshake not answered for longer than 1 s.	<QUIT>, check receiver (switched on and ready?).
E41	RS232 send error; DCD=ON. Handshake not answered for longer than 1 s.	<QUIT>, check receiver (switched on and ready?).
E42	RS232 send error; CTS=OFF. Handshake not answered for more than 1 s.	<QUIT>, check receiver (switched on and ready?).
E43	RS232 send error; transmission of the IC Filtration Sample Processor was interrupted with XOFF for at least 3 s.	<QUIT> or send XON.
E44	RS232 send error; the RS parameters are no longer the same for both devices.	<QUIT>, reset RS parameters for both devices.
E45	RS232 send error; the receive buffer of the 788 IC Filtration Sample Processor contains an incomplete string (L_F missing), the transmission is thus blocked.	<QUIT> or send L_F.
E50…E59	Error in IO test.	<QUIT>, inform Metrohm service.
E60…E82	Error in RS232 test.	<QUIT>, check connection between the RS interfaces.
E201	Functional error.	Inform Metrohm service.

5.2.6 Remote control commands

The remote control tree can be divided into the following main branches:

&	**Root**
├ **M**ode	Method parameters
├ **C**onfig	Instrument configuration
├ **I**nfo	Instrument information
├ **Set**up	Settings of operating mode
├ **U**serMeth	User-defined methods
├ **A**ssembly	Control of assemblies
└ **D**iagnose	Diagnostic tests

The following table lists all relevant objects of the remote control tree for the 788 IC Filtration Sample Processor. Other objects not listed here but still present in the remote control tree are only available with other Metrohm sample changers and lead to an error message with the 788 IC Filtration Sample Processor.

For the unambiguous designation of the objects, the boldface characters suffice. The meaning of the individual object is described here only in brief, for more detailed information please refer to *section 4*. The default values of the objects are printed in boldface.

Object	*Meaning*	*Entry range/Selection*
	&Mode	
&Mode	**Method parameters**	$G, $S, $H, $C
├ **. M**ethod	**Method name** Name of the current method in the working memory	8 ASCII characters
├ **. S**mplNo	**Number of samples in a series**	1...999, ∗, **rack**
├ **. St**artSeq	**Start sequence**	–
│ ├ **. 1**	Line number of the command	–
│ │ ├ **. C**md	Command. The introduction of a command appends the according sub-branch from &Assembly to the index node. A NOP-entry at the end of a sequence appends a new node &Mode.StartSeq.∗.Cmd("NOP").	**NOP**, MOVE, LIFT, SAMPLE, PUMP, SCAN, CTRL, WAIT, ENDSEQ
│ │ └ **. ∗**	Parameter for command. Appended sub-branch from &Assembly… for selected command. Example: &Mode.StartSeq.1.Cmd("MOVE") ⇒ &Mode.StartSeq.1.Move.Target("1") ⇒ &Mode.StartSeq.1.Move.Position("sample")	.MOVE…, .LIFT…, .SAMPLE…, .PUMP…, .SCAN…, .CTRL…, .WAIT…, .END…
│ ∗		
│ ⋮		
│ └ **. 100**	Sequence end	**NOP**
├ **. Sa**mpleSeq	**Sample sequence**	–
│ ├ **. 1**	Line number of the command	–
│ │ ├ **. C**md	Command (see Start sequence)	**NOP**, MOVE, LIFT, SAMPLE, PUMP, SCAN, CTRL, WAIT, ENDSEQ
│ │ └ **. ∗**	Parameter for command (see Start sequence)	.MOVE…, .LIFT…, .SAMPLE…, .PUMP…, .SCAN…, .CTRL…, .WAIT…, .END…
│ ∗		
│ ⋮		
│ └ **. 100**	Sequence end	**NOP**

Object	*Meaning*	*Entry range/Selection*
. FinalSeq	**Final sequence**	–
. 1	Line number of the command	–
. Cmd	Command (see Start sequence)	**NOP**, MOVE, LIFT, SAMPLE, PUMP, SCAN, CTRL, WAIT, ENDSEQ
. *	Parameter for command (see Start sequence)	.MOVE…, .LIFT…, .SAMPLE…, .PUMP…, .SCAN…, .CTRL…, .WAIT…, .END…
*		
. 100	Sequence end	**NOP**
. Changer	**Changer settings**	–
. RackNo	Rack number	**0**…16
. L1Rate	Lift speed	3…**12** mm/s
. ShRate	Turning speed of the rack	3…**20** ang. degrees/s
. ManStop	**Reaction to manual stop**	–
. RemCtl	Command via remote interface	14 bit (1, 0 or *)
. RS Ctl	Command via RS232 interface	14 ASCII characters

&Config

&Config	**Instrument configuration**	–
. Aux	**General instrument settings**	–
. Language	Dialog language	**english**, deutsch, francais, español
. Contrast	Display contrast	0…**3**…7
. Beeper	Beeper on/off	**on**, off
. DevName	Device label	8 ASCII characters
. Prog	Number of program version	read only
. MaxLift	Maximum lift height	0…**125** mm
. RackDef	**Rack definitions**	–
. RackNo	Rack number	**1**…16
. Code	Rack code	**000001**…111111 (6 bit)
. Type	Rack type	**M129-2**, …
. WorkH	Working position	0…**125** mm
. RinseH	Rinsing position	0…**125** mm
. ShiftH	Shift position	**0** mm
. SpecialH	Special position	**0**…125 mm
. Spez Beak	Special beaker positions	–
. 1	Special beaker 1	–
. Pos	Beaker position	**0**…number of rack positions
. 8	Special beaker 8	–
. Pos	Beaker position	**0**…number of rack positions
. PosTab	**Position table**	–
. Idx	Index of the table. Each table contains the following data:	**0**…31
*		
. Name	Name position table	8 ASCII characters
. R1Num	Highest beaker position in row 1	2…(R2Num – 2)
. R2 Num	Highest beaker position in row 2	(R1Num + 2)…(R3Num – 2)
. R3 Num	Highest beaker position in row 3	(R12Num + 2)…200

Object	*Meaning*	*Entry range/Selection*
. **R1O**ff	Offset in 1/10-ang. degrees for positions in row 1	**0**…3599
. **R2O**ff	Offset in 1/10-ang. degrees for positions in row 2	**0**…3599
. **Nu**m	Number of positions (n)	**1**…200
. **1**	Position 1	–
. **V**alue	Position in 1/10-angular degrees	**0**…3599
. **n**	Position n	–
. **V**alue	Position in 1/10-angular degrees	**0**…3599
. **RS**set	**RS232 interface** $G effects all the RS settings.	$G
. **B**aud	Baud rate in bit/s	300, 600, 1200, 2400, 4800, **9600**
. **D**ataBit	Number of data bits	7, **8**
. **S**topBit	Number of stop bits	**1**, 2
. **P**arity	Parity	**none**, odd, even
. **H**andsh	Handshake	**HWs**, HWf, SWchar, SWline, none
. **C**harSet	Character set	**IBM**, Epson, Seiko, Citizen, HP

&Info

&Info	**Instrument information**	–
. **R**eport	**Send formatted reports**	$G
. **S**elect	Selection of the report	**config**, param, usermeth, all
. **A**ctualInfo	**Current information**	–
. **L**ift	Lift station	–
. **1**	Lift 1	–
. **E**xist	Availability	read only
. **M**axHeight	Maximum stroke path	read only
. **A**ctHeight	Current lift position	read only
. **R**ack	**Sample rack**	–
. **C**ode	Rack code	read only
. **T**ype	Rack type	read only
. **W**orkHeight	Working position	read only
. **R**inseHeight	Rinsing position	read only
. **S**hiftHeight	Shift position	read only
. **Sp**ecialHeight	Special position	read only
. **A**ctPos	Current beaker position	read only
. **P**ump	**Pump**	–
. **1**	Pump 1	–
. **S**tate	Current pump state (on, off)	read only
. **I**nputs	**Remote inputs**	
. **S**tatus	Status of the 8 input lines (Input 0…7; 1 = on, low, active; 0 = off, high, inactive) in byte form $$Status = \sum_{n=0}^{7} 2^n$$	read only

Object	*Meaning*	*Entry range/Selection*
. Outputs	**Remote outputs**	
. Status	Status of the 14 output lines (Output 0…13; 1 = on, low, active; 0 = off, high, inactive) in byte form $Status = \sum_{n=0}^{13} 2^n$	read only
. Display	**Display**	–
. L1	Display in LCD line 1	read only
. L2	Display in LCD line 2	read only
. Counter	**Sample counter**	–
. Sample	Current sample position	read only
. Maximum	Number of samples to be worked off	read only

&Setup

&Setup	**Operating mode**	
. IdReport	**Send identification before report** Elements of the message: «Space (dec 32), ', report identification» " 'co" config " 'pa" parameters " 'um" method list	**on**, off
. Keycode	**Send key code of pressed keys** Elements of the message: «Space (dec 32), # or ù, two-place code»	on, **off**

Code	*Key*	*Code*	*Key*
0		16	<7 /SAMPLE>
1	<HOLD / LEARN>	17	<4 / PUMP>
2	<STOP>	18	<1 / SCAN>
3	<START>	19	<0>
4	<CONFIG>	20	<END>
5	<PARAM>	21	<→>
6	<USER METHOD>	22	<CLEAR / RESET>
7		23	<ENTER>
8	<9 / LIFT>	24	<↑>
9	<6 >	25	<↓>
10	<3 / WAIT>	26	<SELECT>
11	<* / ENDSEQ>	27	<QUIT>
12	<8 / MOVE>	28	<HOME>
13	<5>	29	<←>
14	<2 / CTRL>	30	<INSERT>
15	<. / PRINT>	31	<DELETE>

. Tree	**Definition of the response to $Q**	
. Short	Path names are sent with just the required number of characters (boldface characters)	on, **off**
. ChangedOnly	Only path names and their values which have been edited once are sent.	on, **off**
. Trace	**Send path and value on changes** Element of the change message: «Space (dec 32), path, "value"»	on, **off**
. Lock	**Lock functions**	
. Keyboard	Lock all keys	on, **off**
. Config	Locking of <CONFIG> key	on, **off**
. Parameter	Locking of <PARAM> key	on, **off**

Object	*Meaning*	*Entry range/Selection*
. **U**serMeth	Locking of method memory functions	on, **off**
. **R**ecall	Lock recalling of methods	on, **off**
. **S**tore	Locking storage of methods	on, **off**
. **D**elete	Locking deletion of methods	on, **off**
. **D**isplay	Locking of the display function	on, **off**
. **A**utoInfo	**Automatic messages on change** Elements of the automatic message: «Space (dec 32), !, instrument designation, AutoInfo node»	–
. **S**tatus	Switch AutoInfo on/off	**on**, off
. **P**	Message ".P" at simulation of PowerOn	on, **off**
. **C**h	Changer infos	–
. **G**	Message ".G" when method is started	on, **off**
. **R**	Message ".R" when "ready" state is reached	on, **off**
. **S**	Message ".S" when "stop" state is reached	on, **off**
. **H**	Message ".H" when "hold" state is reached	on, **off**
. **C**	Message ".C" when method is continued after "Hold"	on, **off**
. **B**	Message ".B" at start of sample sequence	on, **off**
. **F**	Message ".F" at end of sample sequence	on, **off**
. **O**M	Message ".OM" at start of start sequence	on, **off**
. **CM**	Message ".CM" at start of final sequence	on, **off**
. **E**rror	Message "E" when an error occurs	on, **off**
. **P**owerOn	**Simulation of "Power on"**	$G
. **In**itialize	**Set default values**	$G
. **S**elect	Selection of the branch whose default values have to be set (all = all main branches)	**param**, config, assembly, setup, all
. **R**amInit	**Initialization of working memory** All parameters will be set to default; error messages will be deleted.	$G
. **Ins**trNo	**Instrument number**	$G
. **V**alue	Serial number	8 ASCII characters

&UserMeth

&UserMeth	**User defined methods**	–
. **F**reeMemory	**Memory available**	read only
. **R**ecall	**Load method**	$G
. **N**ame	Method name	8 ASCII characters
. **S**tore	**Save method**	$G
. **N**ame	Method name	8 ASCII characters
. **D**elete	**Delete method**	$G
. **N**ame	Method name	8 ASCII characters
. **DelA**ll	**Delete all methods**	$G
. **L**ist	**List of methods**	–
*		
. **1**	Method 1	–
* . **N**ame	Method name	read only
. **B**ytes	Method size in bytes	read only

Object	*Meaning*	*Entry range/Selection*
	&Assembly	
&Assembly	**Assembly control**	–
. Sample	**Current sample position**	$G
. Func	Selection of function	**=**, +, –
. Value	Value of function	0…**1**…999
. Move	**Turning the sample rack**	$G, $S
. Target	Lift address (only '1' possible)	**1**
. Position	Position	**sample**, spec1…spec8, 1…999
. Lift	**Moving the lift**	$G, $S
. Station	Lift address (only '1' possible)	**1**
. Way	Target position	**rest**, work, rinse, shift, special, 0…125 mm
. Pump	**Pump control**	$G, $S
. Address	Pump address (only '1.1' possible)	**1.1**
. Value	Time or status	**1**…999 s, on off
. Scan	**Scanning the interfaces**	$G, $S
. Address	Selection of interface	**Rm**, RS
. Pattern	Input signal or data for Rm (Remote):	8 × 1, 0 or * (binary) **ready1**, end1, end2, wait1, wait2, wait*, pump1 ?, pump2 ?, pump* ?
	for RS (RS232):	14 ASCII characters
. Ctrl	**Interface control**	$G
. Address	Selection of interface	**Rm**, RS
. Pattern	Output signal or data signal for Rm (Remote):	14 × 1, 0 or * (binary) **INIT**, INIT 732, PROG R/S 1, PROG R/S 2, PUMP R/S 1, FILL A 1, INJECT A 1, FILL B/ STEP 1, INJECT B 1, ZERO 1, PUMP 752 on, PUMP 752 off, STEP MSM 753
	for RS (RS232):	14 ASCII characters, &D.S"9"
. Wait	**Waiting time**	$G, $S, $H, $C
. Time	Waiting time	0…**1**…9999 s
. End	**Trigger reset**	$G

Object	*Meaning*	*Entry range/Selection*
	&Diagnose	
&Diagnose	**Diagnosis** (see *section 6.4*)	
. Init	**Initialization**	$G
└ **. S**elect	Selection of sub-branch whose default values should be set (all = all branches)	**param**, config, assembly, setup, all
. RamTest	**Test working memory**	$G
. LcdTest	**Test display**	$G, $S,$H
. ContrastTest	**Test display contrast**	$G, $S
. KeyTest	**Test keyboard**	$G, $S
. Io Test	**Test remote interface**	$G, $S
. Rs Test	**Test RS232 interface**	$G, $S
. EbusTest	**Test EBUS interface**	$G, $S
. BeeperTest	**Test beeper**	$G, $S
. RackcodeTest	**Test rack code**	$G, $S
. FunctionTest	**Metrohm internal test**	
. SimulateKey	**Key code simulation**	**0**…31
. InstrNo	**Instrument number** (accessible only with &Setup.InstrNo)	–
. PowerOn	**Simulation "Power-on"**	$G

Code	*Key*	*Code*	*Key*
0		16	<7 /SAMPLE>
1	<HOLD / LEARN>	17	<4 / PUMP>
2	<STOP>	18	<1 / SCAN>
3	<START>	19	<0>
4	<CONFIG>	20	<END>
5	<PARAM>	21	<→>
6	<USER METHOD>	22	<CLEAR / RESET>
7		23	<ENTER>
8	<9 / LIFT>	24	<↑>
9	<6 >	25	<↓>
10	<3 / WAIT>	26	<SELECT>
11	<* / ENDSEQ>	27	<QUIT>
12	<8 / MOVE>	28	<HOME>
13	<5>	29	<←>
14	<2 / CTRL>	30	<INSERT>
15	<. / PRINT>	31	<DELETE>

5.2.7 Data transmission protocol

The RS232 interface of the 788 IC Filtration Sample Processor is configured as DTE (Data Terminal Equipment) with the following technical specifications:

- *Standard* — Data interface in accordance with EIA standard RS 232C (DIN 66020, page 1), transmission parameters can be set under **'configuration/RS232 settings'**, see *section 4.2.1*.

- *Control characters*

C_R	DEC 13	HEX 0D
L_F	DEC 10	HEX 0A
XON	DEC 17	HEX 11
XOFF	DEC 19	HEX 13

- *Max. line length* — 80 characters + C_R L_F

- *Mode* — Full duplex (simultaneous transmission and receiving)

  Restriction:
  If data are first received by the interface, transmission is not started until the receipt is at an end.

- *Cable* — For interconnection of the 788 IC Filtration Sample Processor with third-party devices, only a shielded data cable may be used (e.g. METROHM D.104.0201). The cable shield must be perfectly earthed at both devices (pay attention to current loops: always use star earthing). Use only connectors with sufficient shielding (e.g. Metrohm K.210.0001 with K.210.9004).

- *Cable length* — max. ca. 15 m

Start	7 or 8 data bits	parity bit	1 or 2 stop bits

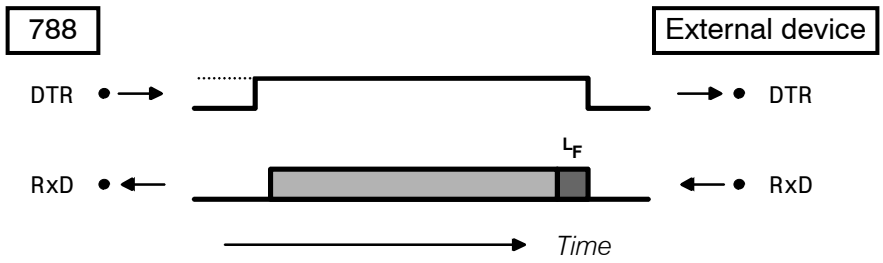
5.2.8 Handshake

No Handshake (none)

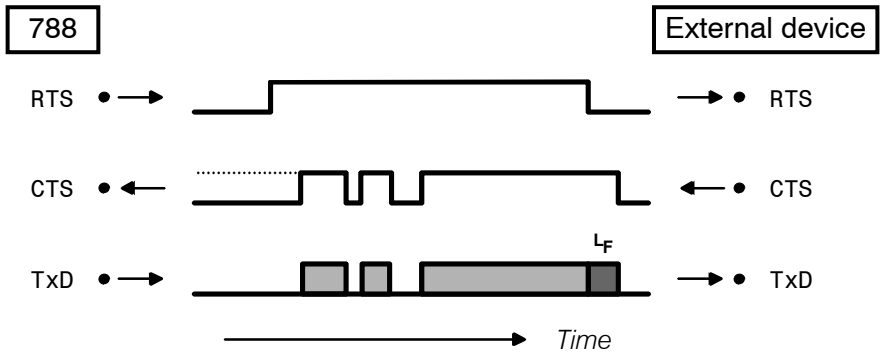
The 788 IC Filtration Sample Processor neither checks handshake inputs (CTS, DSR, DCD) nor sets handshake outputs (DTR, RTS).

Reduced hardware handshake (HWs)

788 IC Filtration Sample Processor as **receiver**:



788 IC Filtration Sample Processor as **sender**:

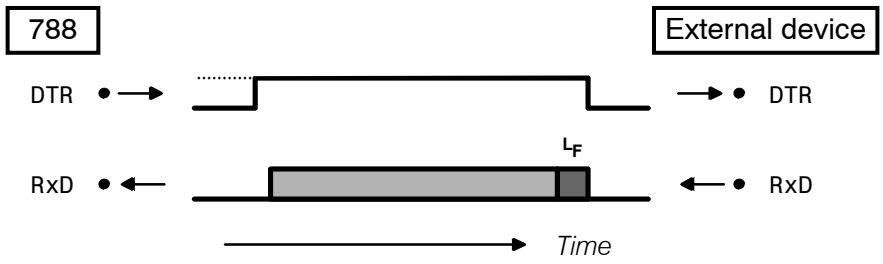


The data flow can be interrupted by deactivating the CTS line.

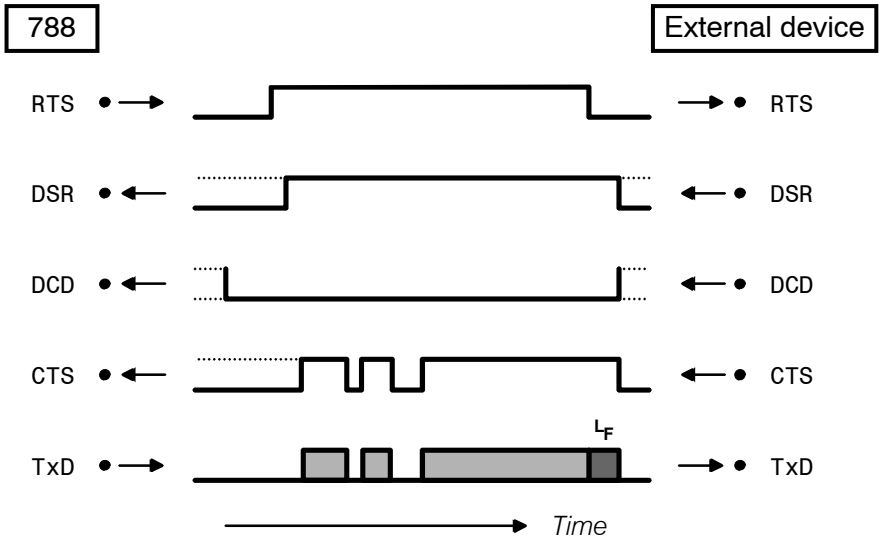
Full hardware handshake (HWf)

All handshake inputs are checked, all handshake outputs are set.

788 IC Filtration Sample Processor as **receiver**:



788 IC Filtration Sample Processor as **sender**:



The data flow can be interrupted by deactivation of the CTS line.

Software handshake with character stop (SWchar)

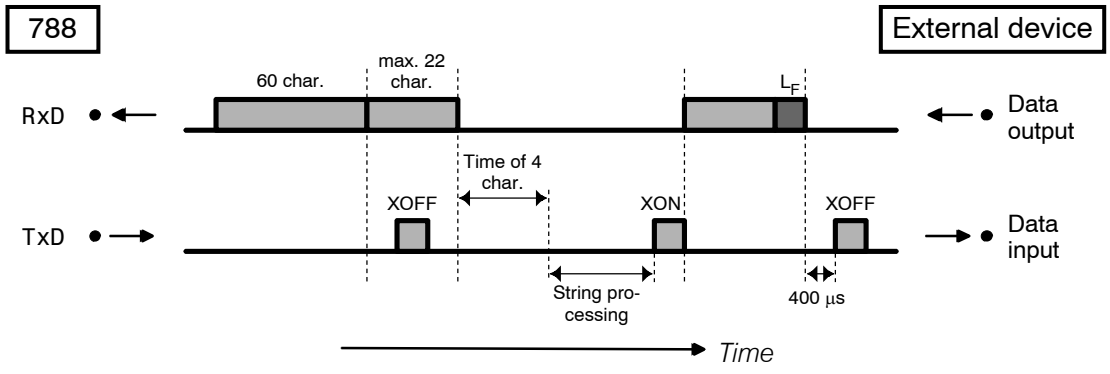
Handshake inputs are (CTS, DSR, DCD) are not checked at the 788 IC Filtration Sample Processor, handshake outputs (DTR, RTS) are set.

As soon as an L_F is recognized, the 788 IC Filtration Sample Processor sends XOFF. After this time, it can still receive 6 characters and store them temporarily.

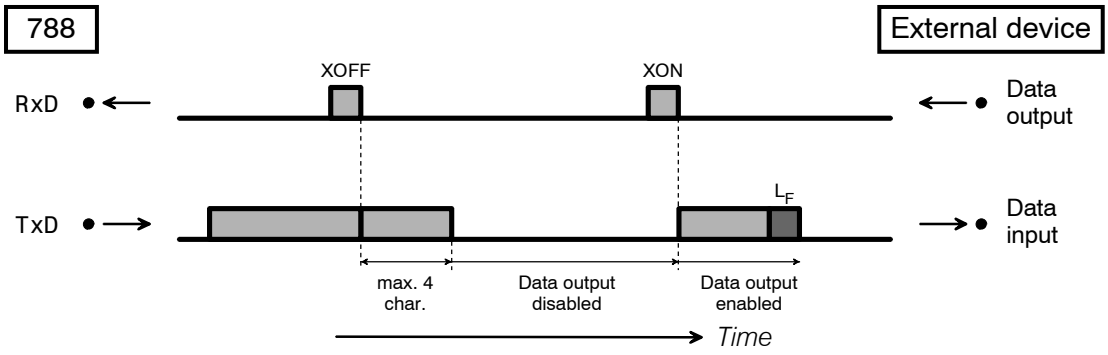
However, the 788 IC Filtration Sample Processor also sends XOFF when its input buffer contains 60 characters. After this time, it can still receive maximum 22 characters (incl. L_F).

If the transmission is interrupted for the time of 4 characters after the 788 IC Filtration Sample Processor has sent XOFF, the string previously received will be processed even if no L_F has been sent.

788 IC Filtration Sample Processor as **receiver**:



788 IC Filtration Sample Processor as **sender**:

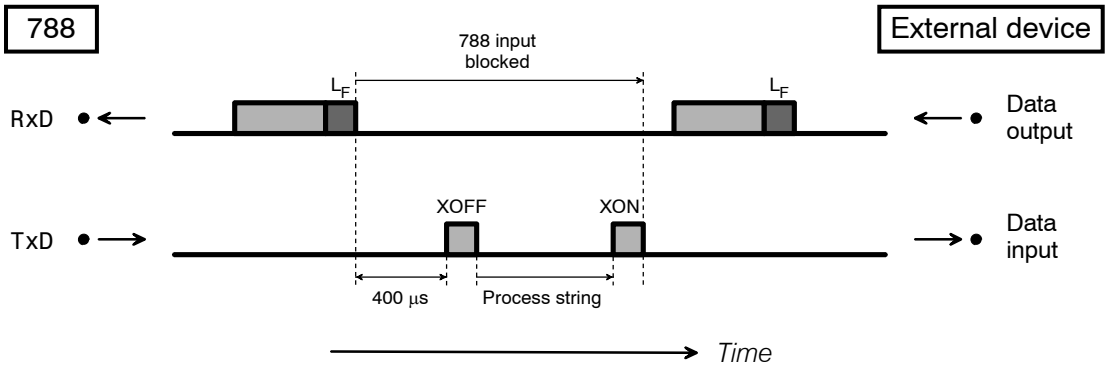


Software handshake with line stop (SWline)

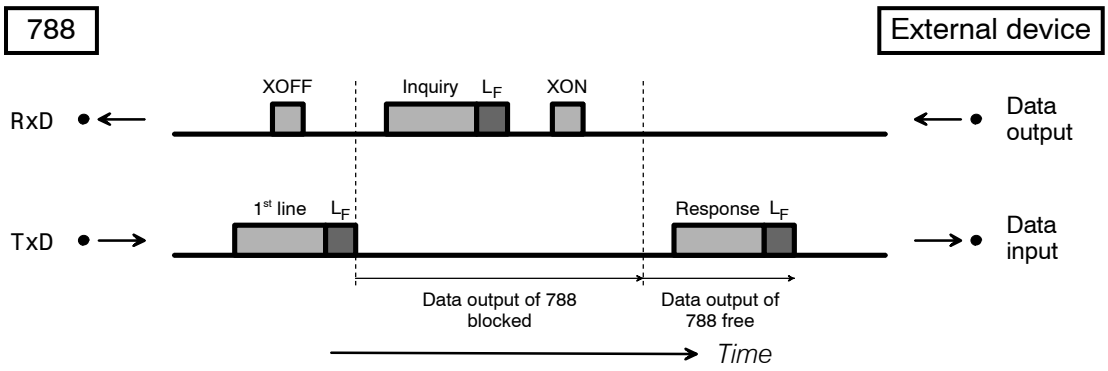
Handshake inputs are (CTS, DSR, DCD) are not checked at the 788 IC Filtration Sample Processor, handshake outputs (DTR, RTS) are set.

The 788 IC Filtration Sample Processor has an input buffer which can accept a string of up to 80 characters + C_R L_F. As soon as an L_F is recognized, the 788 IC Filtration Sample Processor sends XOFF. After this time, it can still receive max. 6 characters and store them temporarily. The string sent previously is now processed by the 788 IC Filtration Sample Processor. It then sends XON and is again ready to receive.

788 IC Filtration Sample Processor as **receiver**:

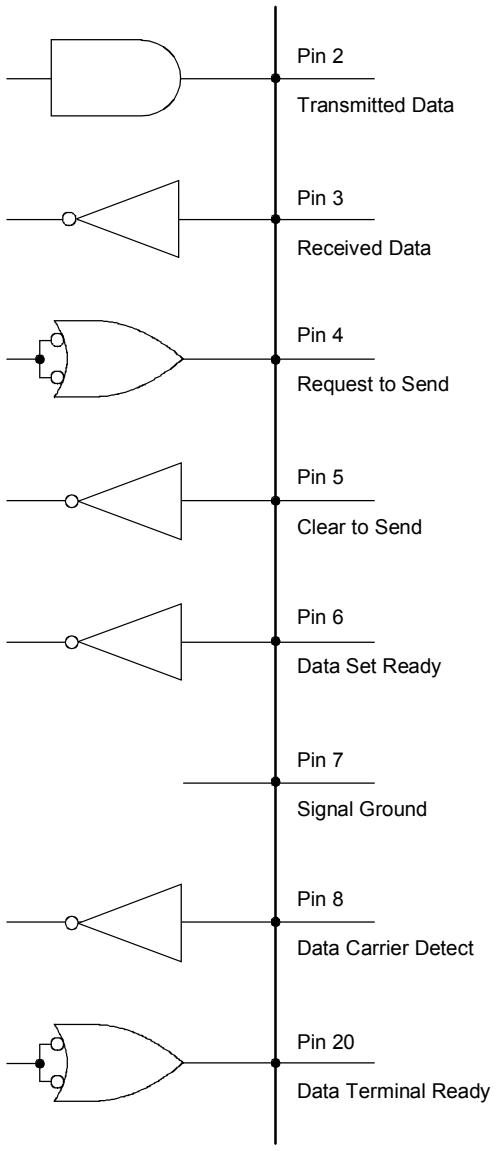
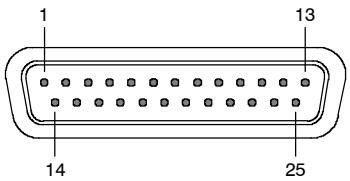


788 IC Filtration Sample Processor as **sender**:



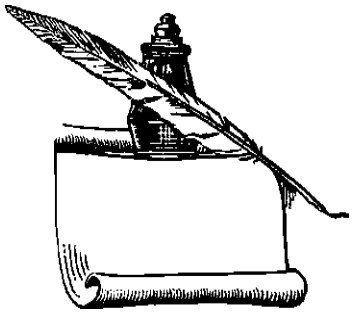
The transmission of the 788 IC Filtration Sample Processor can be stopped by the external device with XOFF. After the receipt of XOFF, the 788 IC Filtration Sample Processor finishes transmission of the line already started. If the data output is blocked for more than 3 s by XOFF, "E43" appears in the display.

5.2.9 Pin assignment

RS232C interface	*external*
Transmitted Data (TxD) If no data transmission takes place, the line is maintained in the "ON" condition. Data are sent only when CTS and DSR are in the "ON" condition and DCD is in the "OFF" condition. **Received Data (RxD)** Data are received only when DCD is "ON". **Request to Send (RTS)** ON condition: 788 IC Filtration Sample Processor is ready to send data. **Clear to Send (CTS)** ON condition: Remote station is ready to receive data. **Data Set Ready (DSR)** ON condition: The transmission line is connected. **Signal Ground (GND)** **Data Carrier Detect (DCD)** ON condition: The received signal level is within the tolerance range (remote station is ready to send data). **Data Terminal Ready (DTR)** ON condition: 788 IC Filtration Sample Processor is ready to receive data.	
Protective earth Direct connection from cable connector to protective earth of the device. **Polarity assignment of the signals** • Data lines (TxD, RxD) Voltage negative (<–3 V): signal status "ONE" Voltage positive (>+3 V): signal status "ZERO" • Control or message lines (CTS, DSR, DCD, RTS, DTR) Voltage negative (<–3 V): OFF status Voltage positive (>+3 V): ON status In the transition region from +3 V to –3 V, the signal status is undefined. **Driver 14C88** to EIA RS 232C specification **Receiver 14C89** to EIA RS 232C specification	**Contact arrangement at the socket "RS 232" (male)**  Connection cables to external devices must have an appropriate 25-pin connector (female). Metrohm offers connector sockets (K.210.9004) and the associated housing (K.210.0001) as an option for the preparation of such cables.
No liability whatsoever will be accepted for damage arising from the improper connection of devices.	

5.2.10 RS232 error rectification

Problem	*Questions for corrective action*
No characters can be received on an attached printer.	⇒ Are the devices switched on and the connecting cables plugged in properly? ⇒ Is the printer set to "on-line"? ⇒ Do the baud rate, data bits and parity for the two devices have the same setting? ⇒ Is the handshake set properly? If everything appears ok, try to print out a report by pressing the <PRINT> key.
No data transmission occurs and an error message appears in the display of the 788 IC Filtration Sample Processor.	⇒ **RS error 36…39**: Receive errors. Do the RS232 data transmission parameters of the two devices have the same setting? ⇒ **RS error 40…42**: transmission errors. Is the cable used correctly wired and plugged in? Is the printer switched on and set to "on-line"? ⇒ **RS error 43**: Data output of the 788 IC Filtration Sample Processor blocked for longer than 3 s by XOFF.
The received characters are garbled.	⇒ Do the data bits and parity of the two devices have the same setting? ⇒ Does the baud rate of the two devices have the same setting? ⇒ Is the correct printer selected? ⇒ The data transfer has been interrupted by the hardware during a printout. Set up connections again, switch printer off then on.



6 Appendix

6.1 Error messages

When an error occurs the execution of the active command is interrupted and an error message is displayed (display blinks). This must be acknowledged with the <QUIT> key.

If an error occurs during processing of a sample series, the 788 IC Filtration Sample Processor will then be switched into the "HOLD" state. After the cause of the error has been rectified, the sample series can be continued with the next command in the active sequence by pressing the <START> key. If the error cannot be eliminated, the method running can also be halted with <STOP>.

The list of possible error messages and their causes:

Error message	*Cause*
*** battery low**	The battery for the permanent storage of user methods must be replaced.
*** wrong rack**	The rack positioned is not the one that was assigned to the method under **'parameters'**.
*** rack data missing**	No sample rack is in position or no rack data can be found for the sample rack that is in place.
*** raise lift first**	Turning of a rack could not be carried out because the lift was below the defined shift position.
*** user memory full**	The memory for the user-defined methods is full. Before saving a new method, methods that are not used or used only rarely must be deleted.

Error message	*Cause*
*** changer low power**	The power supply cannot deliver enough power for the simultaneous operation of all components currently in use (pump, lift).
*** RS232 error**	The transmission parameters of the RS232 interface do not agree with those of the receiving instrument.
*** check rack/swing head**	Invalid configuration of sample rack or swing head.
*** invalid position**	The sample position selected is defined as a special beaker or the special beaker chosen is not defined.
*** invalid rack code**	The rack code read by the 788 IC Filtration Sample Processor could not be found in the internal position tables.
*** changer not ready**	The 788 IC Filtration Sample Processor cannot execute the command chosen because it is busy carrying out another action or it cannot move to the rack position.
*** changer overload**	Load or resistance too large to carry out the chosen action.
trap error xxx	Unexpected program error, turn instrument off and on again.
No display, LEDs tower 1 and tower 2 are lit up	LCD error (system error 7). Please inform Metrohm Service.

6.2 Technical data

Lift

Lift path	ca. 125 mm
Load	ca. 30 N
Stroke speed	adjustable, 3…12 mm/s

Turntable

Turning speed	adjustable, 3…20 angular degrees/s

Pump

Pump type	2-channel peristaltic pump with rotational speed of 20 /min
Pump capacity (with water, without counterpressure; depends on contact pressure)	with 6.1826.010 pump tubing: typ. 1.5…1.7 mL/min with 6.1826.030 pump tubing: typ. 0.5…0.6 mL/min with 6.1826.070 pump tubing: typ. 1.8…2.0 mL/min
Pressure	max. 1.5 bar (0.15 MPa)
Pump tubing material	PVC (Tygon®)

Ultra-filtration cell

Material	Plexiglass (polymethyl methacrylate)
Solvent compatibility	Water, ethanol (no organic sovents!)
Cell volume	2 x 210 µL
Diameter of membrane	47 mm

Parts and controls

LCD-Display	2 lines of 24 characters each, height 5 mm
Keyboard	chemically resistant membrane keypad made of polyester with function and numeric keys

Mains connection

Voltage	100...120 V 220...240 V Switchable with voltage selector in fuse holder (see *section 2.2.1*)
Frequency	50...60 Hz
Power consumption	40 VA
Fuse	5 mm Ø, 20 mm length 100…120 V: 0.5 A (slow-blow) 220…240 V: 0.25 A (slow-blow)

Interfaces

Remote interface	specifications, see *section 5.1*
RS232 interface	specifications, see *section 5.2*

Safety specifications

Construction / Testing	According to IEC 1010 / EN 61010 / UL 3101-1, protection class 1
Safety directions	The Instructions for Use include information and warnings which must be heeded by the user to assure safe operation of the instrument.

Electromagnetic compatibility (EMC)

Emitted interference	Standards met: EN55011 (class B), EN55022 (class B), EN50081-1 01.92
Immunity to interference	Standards met: IEC801-2/IEC1000-4-2 (class 4), IEC801-3/ IEC1000-4-3 (class 2), IEC801-4/IEC1000-4-4 (class 3), IEC801-5/IEC1000-4-5 (class 2/3), IEC801-6/IEC1000-4-6 (class 2), EN55011 (class B), EN55022 (class B), EN50081-1/2 10.92, EN50082-1 03.97, EN61000-3, EN61326-1 03.97

Ambient temperature

Nominal operating range	+5…+40°C (at 20…80 % atmospheric humidity)
Storage, transport	–20…+60°C (at atmospheric humidity< 50 %) –20…+50°C (at atmospheric humidity< 85 %) –20…+40°C (at atmospheric humidity< 95 %)

Housing

Sample changer	Metal case, multiple enameling
Keyboard	Crastin (PBTB), aluminum-steamed on the inside

Dimensions

Width	280 mm
Height	660 mm
Depth	480 mm
Weight	12.4 kg (without accessories)

6.3 Maintenance and servicing

6.3.1 Maintenance by Metrohm service

Maintenance of the 788 IC Filtration Sample Processor is best done as part of an annual service performed by specialists from the Metrohm company. If work is frequently performed with caustic and corrosive chemicals, it may be necessary to shorten the interval between servicing.

The Metrohm service department is always willing to offer expert advice on the maintenance and servicing of all Metrohm instruments.

6.3.2 Care of the unit

The 788 IC Filtration Sample Processor requires proper care and attention. Excessive contamination of the instrument could possibly lead to malfunctions and a shorter service life of the inherently rugged mechanical and electronic parts.

Wipe up spilled chemicals and solvents immediately. The connectors (in particular the power supply) should be protected from contamination. The 788 IC Filtration Sample Processor should never be operated without plug cover (see *section 2.3.3*).

The unit has been constructed in such a way as to virtually eliminate the possibility of penetration of corrosive media into the interior of the instruments. If such a situation does occur, disconnect the mains plug of the 788 IC Filtration Sample Processor immediately to prevent extensive damage to the instrument electronics. Inform Metrohm service if your instrument has been damaged in such a way.

The instrument must not be opened by untrained personnel. Please comply with the safety notes in section 1.5.1.

6.3.3 Replacing the pump tubing

Pump tubings are consumable material with a limited lifetime and should be replaced at regular intervals (approx. every 2 weeks under continuous use).

The working life of pump tubing depends to a considerable extent on the contact pressure. This is why the contact pressure must be correctly set as described in *section 2.3.9*. If the pump is to remain switched off for a lengthy period of time the tubing cartridges should be raised completely by loosening snap-action lever **16** on the right-hand side (the pre-set contact pressure remains unchanged).

To replace a pump tubing proceed as follows:

1 Remove old pump tubing

- Press contact pressure lever **18** on the tubing cartridge down as far as it will go.
- Release tubing cartridge **14** from holding clamp **17** by pressing down snap-action lever **16** and remove from mounting pin **13** at the 788 IC Filtration Sample Processor (see *Fig. 1*).
- Remove old pump tubing.

2 Insert new pump tubing

- Insert the new pump tubing **10** (6.1826.070) or **11** (6.1826.030) in the tubing cartridge as shown in *Fig. 10*. The stopper **43** must click into the corresponding holder on the left-hand side of the tubing cartridge.
- Place the tubing cartridge on mounting pin **13** and press down on the right-hand side until snap-action lever **16** clicks into position on holding clamp **17**. Take care that no kinks are formed in the pump tubing.

3 Set contact pressure

- Press contact pressure lever **18** upwards until the solution just starts to be drawn in. Then press contact pressure lever upwards until it clicks once more to obtain optimal contact pressure.

The 6.1826.0X0 pump tubing is made of PVC and must not be used for rinsing with solutions which contain acetone. In such cases, rinse with different pump tubing or a different pump.

6.3.4 Replacing the filtration membrane

A good condition of the filtration membrane is a prerequisite for a constant quality of the analysis results. Therefore, the membrane has to be replaced regularly.

Please consider section 4.7 for evaluating the membrane type and time of exchange.

Replace the filtration membrane as follows, see also Fig. 9 in *section 2.3.8*.

1 Prepare ultra-filtration cell

- Remove all tubings at the ultra-filtration cell **34** by opening all PVDF compression fittings **22**.
- Using the 6.2621.070 Allen key, completely loosen the 5 screws **46**, separate top part **43** from bottom part **45** and remove sealing ring **44**.
- Thoroughly rinse the sealing ring, bottom part and top part of the dialysis cell with ultrapure water.

*Use only **ultrapure water** or **ethanol** to clean the dialysis cell; organic solvents (e.g. acetone) will cause damage to the plexiglas cell!*

2 Prepare filtration membrane

- Use the 6.2831.010 tweezers to extract a new filtration membrane **50** (6.2714.020) from its packaging and immerse in a Petri dish containing ultra pure water for approx. 2 min until the membrane is completely saturated with water.

Because the filtration membrane it is stretched out thereby, it has to be watered before inserting into the ultra-filtration cell. Otherwise, the membrane could be crumbled in the cell, which leads to blocking.

3 Insert filtration membrane

- Lay top part **43** on a paper wipe with its inside facing upwards.
- Insert sealing ring **44** in the appropriate recess in the top part.
- Using the tweezers, place the wet dialysis membrane inside the sealing ring on the top part of the filtration cell.

*Do not connect the dialysis cell with anything other than the **6.2744.000 PVDF compression fittings** supplied. If 6.2744.010 PEEK compression fittings are used, stress cracks may appear in the ultra-filtration cell !*

4 Close ultra-filtration cell

- Insert sealing ring in the appropriate recess in top part **43**.
- Place top part on bottom part **45** so that both parts lie flush.
- Using the 6.2621.070 Allen key, screw the 5 screws **46** right in and tighten up.

5 Attach ultra-filtration cell

- Insert the assembled ultra-filtration cell in the cell holder **26** according to Fig. 1 or Fig. 11. The heads of the five screws **46** fit to the small holes of the cell holder.

- Connect all three tubings according to step 3 to 5 in *section 2.3.9* to the corresponding inlet and outlet openings of the ultra-filtration cell by using PVDF compression fittings **22**.

6 Rinse ultra-filtration cell

- Every time the filtration membrane is changed, the remaining air in the cell and tubings has to be removed. This can be done by rinsing with ultrapure water.

- A completely installed 788 IC Filtration Sample Processor with ultra-filtration cell is required for processing the following steps. The rinsing solution (e.g. ultrapure water) is stored in a 300 mL PE bottle on the special beaker position 1. The 788 IC Filtration Sample Processor is online and in normal state. The pump is switched of (display: '`PUMP—'`) and the 788 is ready for use (display: '`ready`').

- Turn the sample rack to position the beaker with the rinsing solution under the needle by pressing <MOVE> followed by choosing '`spec.1`' with <SELECT>.

- Lower the lift into rinse position with <LIFT> and <SELECT> '`rinse`'

- Turn on the pump by pressing <PUMP>. All connected tubings and the ultra-filtration cell will be rinsed.

- After adequate time (e.g. 5 min.), switch off the Pump (<PUMP>) and raise the lift to its rest position by pressing <HOME>.

6.4 Diagnosis

6.4.1 General Information

The 788 IC Filtration Sample Processor is a very precise and reliable control instrument. Thanks to its rugged construction, its functions are rarely influenced by mechanical or electrical affects.

Although an occasional fault in the instrument can not be excluded completely, it is certainly much more likely that malfunctions are caused by wrong operation or handling or by improper connections and operation with non-Metrohm instruments.

In any case it is advisable to localize the error with the quick and easy-to-use diagnostic functions. Metrohm Service only needs to be contacted if an actual error is apparent in the instrument. Additionally, the service technician can be much more precisely informed with the aid of the results of the specific built-in diagnostic functions.

In inquiries always quote the serial number **38** (see *Fig. 2*) and program version (see **program**, *section 4.2.1* "Configuration") and specify possible error displays.

Procedure

The following test list shows all components for which there are detailed instructions (diagnostic steps) to check their functionality.

If there is a possible malfunction we recommend following the instructions of the corresponding diagnosis step or running all the diagnosis steps as a routine check of the instrument.

The reaction of the 788 IC Filtration Sample Processor to the instructions should be compared with the description in the diagnosis step. If the instrument exhibits an unexpected reaction ("no" situation), the diagnosis step should be re-run to rule out operating error. Several false reactions however, indicate a high probability of a disorder.

Components	***see section***
Working memory (RAM)	*section 6.4.3*
Display	*section 6.4.4*
Keyboard	*section 6.4.5*
Remote	*section 6.4.6*
RS 232	*section 6.4.7*
External Bus	*section 6.4.8*
Beeper	*section 6.4.9*
Rack code	*section 6.4.10*

Required Instruments:

Only required, if the RS232 or remote interface is to be checked:

- 3.496.8550 Test plug (on the "Remote" plug)
- 3.496.8480 Test plug (on the "RS 232" plug)

6.4.2 Preparing the instrument

- Disconnect power plug.
- Remove cables to the "RS232" and "Remote" interfaces.
- Plug in power plug and immediately press <9> and keep it depressed until the start test pattern disappears.
- Alternatively, the <RESET> key can be pressed to cause a reset followed by pressing (within 0.4 sec) and holding down the <9> key to open the diagnosis menu.

Switch on and 

or 

and 

Main menu Diagnosis:

diagnosis >RAM initialization
diagnosis >RAM test
diagnosis >display test
diagnosis >display contrast test
diagnosis >key test
diagnosis >remote test
diagnosis >RS232 test
diagnosis >external bus test
diagnosis >beeper test
diagnosis >rack code test
diagnosis >function test
diagnosis >instrument number
diagnosis >power on reset

Open the submenu with <ENTER>

Use <↑> or <↓> to access one menu item up or down
Use <HOME> or <END> to access first or last menu item
<QUIT> returns to the normal state

The "function test" is a Metrohm internal test which should be run only by service personal. Before starting this test, the needle must always be removed from the needle holder, otherwise it would be damaged.

6.4.3 Working memory (RAM)

This diagnosis step completes a non-destructive test over the entire range of the RAM contents (working memory).

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <🡻> several times until

```
diagnosis
>RAM test
```

- <ENTER>

If no errors are found, this appears on the display:

```
>RAM test
 RAM test ok
```

- <ENTER>

```
diagnosis
>display test
```

6.4.4 Display

With this diagnosis step, the functionality of the LED's and the display is tested.

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary press <🡻>several times until

```
diagnosis
>display test
```

- <ENTER>

After pressing the <ENTER> key, the program automatically makes a test run to visually check the LED's and the display.

⇒ *The LEDs for **TOWER 1**, **TOWER 2** and **LEARN** blink one after the other for a short time.*

⇒ *The background lighting of the display is switched off for a short time and then turned on again.*

⇒ *The start test pattern appears (every pixel active).*

⇒ *Both lines of the display are turned off.*

⇒ *Both lines of the display are occupied one after the other with the characters "#", "**H**" and finally "I".*

⇒ *Both lines are filled from right to left with the endless running line "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ.".*

- The test run can be stopped and started again by pressing the <5> key.
- The test can be exited with the <QUIT> or <STOP> keys.

```
diagnosis
>display contrast test
```

- <ENTER>

After pressing the <ENTER> key the following display appears whereby the contrast of the display continuously varies between bright and dark.

```
>display contrast test
788 IC Filtr. Processor
```

- The test can be exited with the <QUIT> or <STOP> key.

```
diagnosis
>key test
```

6.4.5 Keyboard

This diagnosis step allows all the keys on the keyboard to be tested for their functionality.

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <↓> several times until

```
diagnosis
>key test
```

- <ENTER>

```
>key test
```

- Activate all the keys one after the other and check their reaction on the display.

The corresponding matrix code appears in the display and a description of the main function of the key pressed (for example, the following display should appear when the <CONFIG> key is pressed).

```
>key test
 code  4   CONFIG
```

- The test is exited by pressing the <STOP> key twice.

```
diagnosis
>remote test
```

Key code table

Code	Key	Code	Key
0		16	<7 / SAMPLE>
1	<HOLD / LEARN>	17	<4 / PUMP>
2	<STOP>	18	<1 / SCAN>
3	<START>	19	<0>
4	<CONFIG>	20	<END>
5	<PARAM>	21	<→>
6	<USER METHOD>	22	<CLEAR / RESET>
7		23	<ENTER>
8	<9 / LIFT>	24	<↑>
9	<6>	25	<↓>
10	<3 / WAIT>	26	<SELECT / TOWER>
11	<* / ENDSEQ>	27	<QUIT>
12	<8 / MOVE>	28	<HOME>
13	<5>	29	<←>
14	<2 / CTRL>	30	<INSERT >
15	<. / PRINT>	31	<DELETE>

6.4.6 Remote interface

This diagnosis step tests the functionality of all the output (14) and input lines (8).

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <↓> several times until

```
diagnosis
>remote test
```

- <ENTER>

```
>remote test
 remote test connector ?
```

- Plug 3.496.8550 test plug into the remote interface without turning the instrument off.
- <ENTER>

The test runs automatically. If no error occurs, the following appears:

```
>remote test
 remote test ok
```

- Remove test plug and press <ENTER>.

```
diagnosis
>RS232 test
```

6.4.7 RS232 interface

This diagnosis step tests the functionality of the serial interface.

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <↓> several times until

```
diagnosis
>RS232 test
```

- <ENTER>

```
>RS232 test
 RS232 test connector ?
```

- Insert the 3.496.8480 test plug into the RS232 interface without turning off the instrument.
- <ENTER>

The test runs automatically. If no error occurs, the following appears:

```
>RS232 test
 RS232 test ok
```

- Remove test plug and press <ENTER>.

```
diagnosis
>external bus test
```

6.4.8 External Bus interface

This diagnosis step tests the functionality of parts of the internal EBUS interface.

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <↓> several times until

```
diagnosis
>external bus test
```

- <ENTER>

If no error occurs, the following identification appears on the display:

```
>external bus test
 address 0x86  type 3
```

- <ENTER>

```
>diagnosis
>beeper test
```

6.4.9 Beeper

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary, press <↓> several times until

```
diagnosis
>beeper test
```

- <ENTER>

The beeper is turned on and off in an endless loop.

```
>beeper test
```

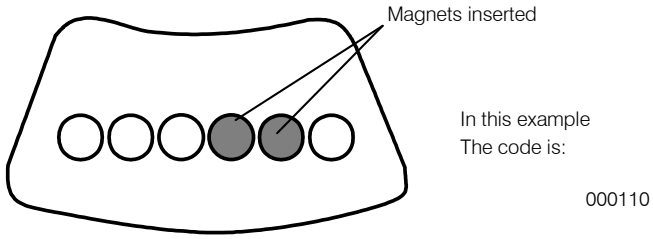
- The test can be exited by pressing the <QUIT> or <STOP> keys.

```
diagnosis
>rack code test
```

6.4.10 Rack code recognition

This diagnosis step checks the functionality of the sensors with regard to their ability to automatically recognize the attached rack.

- Note the code (magnets) on the underside of all the racks being used. The following diagram shows the magnet fixture on the underside of a rack.



Magnet fixture as viewed from underneath

- Pick up the rack and lay it on its side.
- Prepare the instrument for diagnosis (see *section 6.4.2*).
- If necessary press <↓> several times until

```
diagnosis
>power on reset
```

- <ENTER>

The sample changer runs through its start routine (initializing lift and rack positions). The initialization is important because it is vital for the following diagnosis step "rack code test" that the rack is in the basic position.

- Prepare instrument for diagnosis (see *section 6.4.2*).
- If necessary press <↓> several times until

```
diagnosis
>rack code test
```

- <ENTER>

The test reads the code continuously and displays it immediately. For representation on the screen a 6-place bit pattern is provided (code ??????). The first position is for magnet no. 1, the second position for magnet no. 2, etc. If a magnet is recognized, a "1" is written into the corresponding position, otherwise a "0" is assigned.

- Position all racks which are used one after the other and compare the notes made before the test with the information on the display.

```
>rack code test
 code 000000
```

Example for:
no rack in position

```
>rack code test
 code 011000
```

Example for:
Rack with a code as in the example above

- The test can be stopped by pressing the <QUIT> or <STOP> keys.

```
diagnosis
>function test
```

The diagnosis can be exited from the main menu with <QUIT> or <STOP>.

6.5 Initialize data memory

This diagnostic step can be used to write default values to the instrument parameters using the keypad and thus switch the instrument to the original condition. This measure is important with the following two points:

The setting of certain instrument parameters such as the locking of keys is possible only via RS232, i.e. with the aid of a PC. If such instrument parameters are set and no PC is available to cancel the settings, full use can not be made of the instrument.

In rare cases, it is possible that major interference signals such as line spikes and lightning can have an adverse influence on the contents of the data memory. If the contents of the data memory are undefined, this may lead to a system crash.

The 788 IC Filtration Sample Processor offers various possibilities to initialize the data memory. The entire data memory (**`all`**) or only parts of it (**`param, config, setup, assembly`**) can be written to with default values.

*Although the instrument number and the standard methods will be retained, the entire data memory initialization (**`all`**) should be performed only if necessary as the stored user methods are deleted.*

- Prepare instrument for diagnostic test (see *section 6.4.2*).
- If need be, press <9> key repeatedly until

```
diagnosis
>RAM initialization
```

- Press <ENTER> key to open the following diagnostic menu:

`>RAM initialization` `select: param`	Set method parameters with default values.
`>RAM initialization` `select: config`	Set config parameters with default values.
`>RAM initialization` `select: setup`	Set setup parameters with default values.
`>RAM initialization` `select: assembly`	Set assembly parameters with default values.
`>RAM initialization` `select: all`	Set all above parameters with default values and deletes all user-defined methods.

- Pressing the <SELECT> key selects the submenus in turn. The individual initialization alternatives are accessed using the <ENTER> key, exit is with the <QUIT> key.
- The table shows which parts of the data memory are affected by the corresponding initialization alternatives. When the instrument reacts with a system crash after being switched on (undefined display, no reactions to keystroke, etc.) we recommend to carry out the initialization with the submenu **`'all'`**.
- If need be, press the <SELECT> key repeatedly until:

```
>RAM initialization
select:              all
```

- Press <ENTER>.

```
diagnosis
>RAM test
```

- Press <QUIT>.

The instrument quits the diagnostic menu and runs a power on reset.

6.6 Validation / GLP

GLP (**G**ood **L**aboratory **P**ractice) requirements include the periodic check of analytical instruments for reproducibility and accuracy using **S**tandard **O**perating **P**rocedures (**SOP**).

Although the instrument in question is not a measuring instrument, it is recommended to include the 788 IC Filtration Sample Processor in the validation of an analytical system as a part of it.

Checking of the electronic and mechanical components of measuring instruments can and should be undertaken by qualified personnel of the manufacturing company as part of regular servicing. All Metrohm instruments are provided with start-up test routines which check that the relevant assemblies are working perfectly when the instrument is switched on. If no error message is displayed, it can be assumed that the instrument is functioning faultlessly. Instruments from the Metrohm company are also supplied with built-in diagnostic programs which enable the user to check the functioning of certain components in the event of malfunctions or faulty behavior and to localize the fault. Diagnostic programs may also be integrated in a validation procedure.

6.7 Warranty and conformity

6.7.1 Warranty

The warranty on our products is limited to defects that are traceable to material, construction or manufacturing error which occur within 12 months from the day of delivery. In this case, the defects will be rectified in our workshops free of charge. Transport costs are to be paid by the customer.

For day and night operation, the warranty is limited to 6 months.

Glass breakage in the case of electrodes or other parts is not covered by the warranty. Checks which are not a result of material or manufacturing faults are also charged during the warranty period. For parts of outside manufacture insofar as these constitute an appreciable part of our instrument, the warranty stipulations of the manufacturer in question apply.

With the regard to the guarantee of accuracy, the technical specifications in the instruction manual are authoritative.

Concerning defects in material, construction or design as well as the absence of guaranteed features, the orderer has no rights or claims except those mentioned above.

If damage of the packaging is evident on receipt of a consignment or if the goods show signs of transport damage after unpacking, the carrier must be informed immediately and a written damage report demanded. lack of an official damage report releases Metrohm from any liability to pay compensation.

If any instruments and parts have to be returned, the original packaging should be used if at all possible. This applies above all to instruments, electrodes, burette cylinders and PTFE pistons. Before embedment in wood shavings or similar material, the parts must be packed in a dust-proof package (for instruments, use of a plastic bag is imperative). If open assemblies are enclosed in the scope of delivery that are sensitive to electromagnetic voltages (e.g. data interfaces etc.) these must be returned in the associated original protective packaging (e.g. conductive protective bag). (Exception: assemblies with built-in voltage source belong in a non-conductive protective packaging).

No warranty responsibility whatsoever will be accepted by Metrohm for damage which arises as a result of non-compliance with these instructions.

6.7.2 EU Declaration of conformity

CE

EU Declaration of Conformity

The METROHM AG company, Herisau, Switzerland hereby certifies that the instrument:

788 IC Filtration Sample Processor

meets the requirements of EC Directives 89/336/EWG and 73/23/EWG.

Source of the specifications

EN 50081	Electromagnetic compatibility, basic specification Emitted Interference
EN 50082-1	Electromagnetic compatibility, basic specification Interference Immunity
EN 61010	Safety requirements for electrical laboratory measurement and control equipment

Description of the instrument

Sample changer for automatic processing and filtration of sample series with ion chromatographic methods

Herisau, February 09, 2001

Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager

6.7.3 Certificate of conformity and system validation

Certificate of Conformity and System Validation

This is to certify the conformity to the standard specifications for electrical appliances and accessories, as well as to the standard specifications for security and to system validation issued by the manufacturing company.

Name of commodity:	**788 IC Filtration Sample Processor**	
Name of manufacturer:	Metrohm Ltd., Herisau, Switzerland	
Principal technical information:	Voltages:	100…120, 220…240 V
	Frequency:	50…60 Hz

This Metrohm instrument has been built and has undergone final type testing according to the standards:

IEC801-2/IEC1000-4-2 (class 4), IEC801-3/IEC1000-4-3 (class 2), IEC801-4/IEC1000-4-4 (class 3), IEC801-5/IEC1000-4-5 (class 2/3), IEC801-6/IEC1000-4-6 (class 2), EN55011 (class B), EN55022 (class B), EN50081-1/2 10.92, EN50082-1 03.97, EN61000-3, EN61326-1 03.97 — *Electromagnetic compatibility*

IEC1010, EN61010, UL3101-1 — *Security specifications*

It has also been certified by the Swiss Electrotechnical Association (SEV), which is member of the International Certification Body (CB/IEC).

The technical specifications are documented in the instruction manual.

The system software, stored in Read Only Memories (ROMs) has been validated in connection with standard operating procedures in respect to functionality and performance. The features of the system software are documented in the instruction manual.

Metrohm Ltd. is holder of the SQS-certificate of the quality system ISO 9001 for quality assurance in design/development, production, installation and servicing.

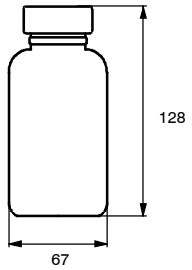
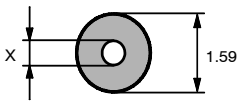
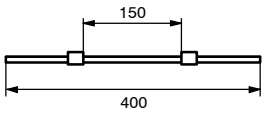
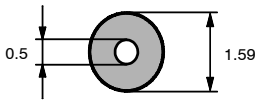
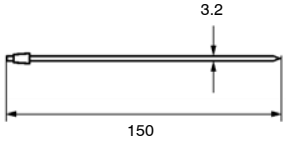
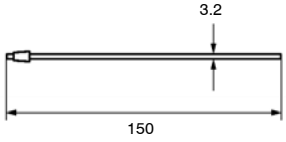
Herisau, February 09, 2001

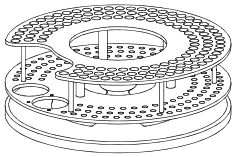
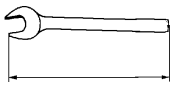
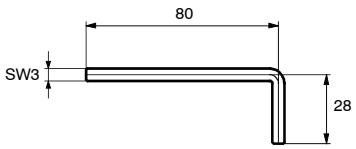
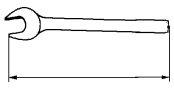
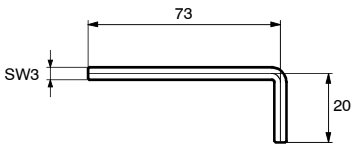
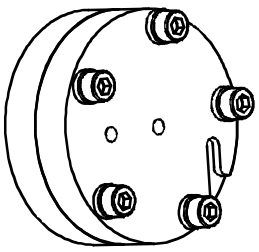
Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager

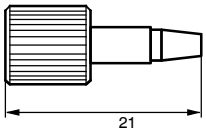
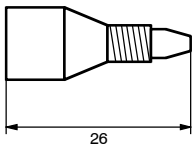
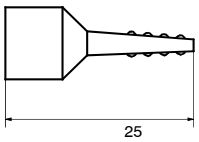
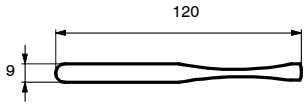
6.8 Standard equipment

Subject to changes !
In figures, all dimensions are given in mm.

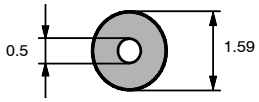
The 2.788.0010 IC Filtration Sample Processor includes the following parts:

Quant.	Order No.	Description
2	6.1608.080	**PE Bottle 300 mL** Bottle for special beaker positions 1 (128) and 2 (129) 
		PTFE Capillary outer diameter: 1/16 " **X (i.d.) [mm] Length [cm]** 
1	6.1803.050	0.50 20
1	6.1803.060	0.97 20
1	6.1803.070	0.97 40
2	6.1803.080	0.97 100
		Pump tubing made of PVC (Tygon®); with 2 firmly attached stoppers; **color code i.d. [mm] e.d. [mm]** 
2	6.1826.010	white/white 1.02 2.72
2	6.1826.030	orange/yellow 0.51 2.21
2	6.1826.070	yellow/yellow 1.42 3.02
2	6.1831.060	**PEEK Capillary** Length = 100 cm 
1	6.1835.010	**PEEK Needle** For aspiration of solutions from sealed sample tubes 
1	6.1835.020	**PEEK Tube** For aspiration of solutions from open sample tubes 

Quant.	Order No.	Description
1	6.2041.430	**Sample rack (M129-2)** For 127 sample tubes 6.2743.050 (11 mL) and 2 PE bottles 6.1608.080 (300 mL) 
1	6.2122.0X0	**Mains cable** To customer's specifications: Cable socket — Cable connector Type IEC 320/C 13 — Type SEV 12 (CH…) ..... 6.2122.020 Type IEC 320/C 13 — Type CEE (7), VII (D…) ..... 6.2122.040 Type CEE (22), V — Type NEMA 5-15 (USA…) 6.2122.070
1	6.2141.110	**Connection cable** Connection cable 788 IC Filtration Sample Processor – 732/1 IC Detector – 709/1 IC Pump
1	6.2142.010	**Keyboard** For 788 IC Filtration Sample Processor
1	6.2621.060	**Open-end spanner 5/16"** 
1	6.2621.070	**Allen key 5 mm** For Allen screws on ultra-filtration cell 
2	6.2621.090	**Open-end spanner ½"** 
1	6.2621.100	**Allen key 3 mm** For Allen screws on sample rack and for splash protection 
1	6.2714.020	**Filtration membrane** Regenerated Cellulose; ∅ 47 mm; nominal pore size 0.15 µm; set of 50 pcs
1	6.2729.110	**Ultra filtration cell (plexiglass)** incl. the following accessories: 1 × E.301.0111 NBR sealing ring 5 × V.022.6030 Steel screw 5 × 4.754.4090 POM washer for screw 3 × 6.2744.060 Dummy stopper for blocking inlet and outlet openings 

Quant.	Order No.	Description
1	6.2743.050	**PP Sample tube (11 mL)** For 6.2041.430 sample rack; set of 2000
2	6.2743.070	**PP Cap** For sealing the 6.2743.050 sample tubes; set of 2000
1	6.2744.000	**PVDF Compression fitting** For connecting 6.1803.0X0 PTFE capillaries to the filtration cell, set of 5 
1	6.2744.010	**PEEK Compression fitting** For connecting 6.1831.0X0 PEEK capillaries or 6.1803.0X0 PTFE capillaries, set of 5 
1	6.2744.030	**PEEK Coupling** Connection between 6.2744.010 PEEK compression fitting and 6.1826.0X0 pump tubing ; set of 4 
1	6.2751.040	**Splash protection** Must be installed at the tower of the 788 IC Filtration Sample Processor.
1	6.2752.010	**Plug cover** Must be installed at the 788 IC Filtration Sample Processor..
2	6.2755.000	**Tubing cartridge** For peristaltic pump on 788 IC Filtration Sample Processor
1	6.2831.010	**Pincette** For handling filtration membranes 
1	8.788.1003	**Instructions for use (English)** For 788 IC Filtration Sample Processor
1	8.788.1013	**Quick Reference Guide (English)** For 788 IC Filtration Sample Processor

6.9 Optional accessories

Order No.	*Description*
6.1831.040	**PEEK Capillary** Length = 15 cm For the connection of two injection valves at the 733 IC Separation Center 
6.2125.090	**Connection cable** Connection cable 788 IC Filtration Sample Processor – 6.2125.120 Adaptor
6.2125.120	**Adaptor for remote connection** **W**ith 5 connections for remote cables
6.2141.120	**Connection cable** Connection cable 788 IC Filtr. Sample Proc. – 732/2 IC Detector – 709/2 IC Pump
6.2743.040	**PP Sample tube (2.5 mL)** For 6.2041.430 sample rack; set of 2000; not recommended for use with ultra-filtration cell

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